A DYNAMICAL SYSTEMS THEORY EXAMINATION OF SOCIAL CONNECTIONS IN OUTDOOR RECREATION PROGRAMS

by

Jeremy Jostad

A dissertation submitted to the faculty of
The University of Utah
in partial fulfillment of the requirements for the degree of

Doctor of Philosophy

Department of Parks, Recreation, and Tourism

The University of Utah

December 2015

The University of Utah Graduate School

STATEMENT OF DISSERTATION APPROVAL

The dissertation of **Jeremy Jostad**

has been approved by the following supervisory committee members:

Robert J. Sibthorp	, Chair	**9/11/2015** Date Approved
Karen Paisley	, Member	**9/11/2015** Date Approved
Edward Ruddell	, Member	**9/11/2015** Date Approved
Jonathan Butner	, Member	**9/11/2015** Date Approved
Maria Newton	, Member	**9/11/2015** Date Approved

and by **Kelly Bricker**, Chair/Dean of the Department/College/School of **Parks, Recreation, and Tourism**

and by David B. Kieda, Dean of The Graduate School.

ABSTRACT

Adolescence is a developmental time period in which social connections are an important aspect to fostering positive growth and identity. Outdoor Adventure Education (OAE) programs are strategically positioned to help in this developmental process because of the novel social environment, however, little is known about how these types of social outcomes develop among adolescents on OAE courses. One challenge within OAE research are the numerous components that can make it difficult to suggest outcomes are a result of single variable effects. This dissertation uses dynamical systems theory (DST) to understand the developmental process of adolescent social connections and to take on the challenges of the multicomponent nature of research in OAE.

The following dissertation is comprised of three articles that seek to better understand how adolescents develop social connections within the context of OAE. First, the variables that may be related to the development of social connections were investigated. A multidimensional group-identification framework was used to operationalize "connection." For the affective and cognitive dimension, students with higher levels of goal conflict had lower levels of identification and students with higher levels of social status had higher levels of identification. Groups with leaders who showed more considerate behaviors and groups that had more female students showed higher levels of identification in the affective dimension only. Identification did not significantly change from day ten of the course to the end (day 30). Though this study

found some significant predictors, the social group in OAE is a complex system with many moving parts and may be better explained through a different theoretical lens.

To take on the complexities of research in the OAE context, the theoretical foundations and analysis procedures of DST were introduced. Dynamical systems theory recognizes the multicomponent nature of phenomena and seeks to describe the temporal patterns of change. This paper illustrates the application and promise of quantitatively modeling dynamical systems in OAE.

Lastly, a study which uses a DST framework and modeling techniques, discussed in Chapter 2, is used to further understand the development of social connections. Data were collected for 12 consecutive days on six OAE courses. The results show a single stable point that students converged upon over time. Students with higher levels of process conflict converged upon this stable point at a faster rate and this point became more stable. Students with higher levels of instructor support showed a higher stable value than those with lower levels of instructor support. These findings are discussed in relation to current literature and theory in OAE.

To Donna Teifer…thank you for raising such an amazing daughter. We miss you!

TABLE OF CONTENTS

LIST OF FIGURES

Figures

ACKNOWLEDGMENTS

There are many who have contributed to this process and this dissertation. Like any system, there have been multiple components that have influenced this entire journey. First and foremost, thank you to my incredible wife. Tasha, I admire the incredible strength you have had throughout this process and the strength you have provided to me. Whatever happens in life I always know I am stronger when you are by my side.

Thank you so much to my committee! Jim, you stuck by me even through my struggles. You pushed me to be a better thinker, writer, and academic. Thank you, Karen, for constantly helping me through difficult times and providing support when needed. I am a better writer and can see the world through a different lens because of you! Jon, you are quite simply incredible. Thank you for making systems understandable and for always encouraging me. Even when I thought that I could not do it, you encouraged me to think differently! Thank you to Ed and Maria for their constant support throughout the entire process.

Lastly, thank you to the wilderness and the students I have had the opportunity to interact with in this setting. These experiences have simply been magical! Finishing this dissertation was only possible due to what I have learned through spending weeks in the wilderness and the motivation of continually wanting to share this magic with others!

CHAPTER 1

INTRODUCTION

Adolescence is a developmental time period in which social connections are an important aspect to fostering positive growth and identity (Lerner, 2002). There are numerous developmental outcomes sought during this time period such as self-efficacy, confidence, moral reasoning, and social competence (Goosens, 2006). Recreation programs provide an arena for adolescents to interact in such a way that helps them reach these developmental outcomes. The interpersonal relationships, or social connections, that adolescents have with their peers can play an important role in achieving many of these outcomes (Horn, 2011). One sector of recreation that offers a unique setting in which to develop social connections is outdoor adventure education (OAE) programs.

One of the main components of OAE programs is the novel social environment (Walsh & Golins, 1976). The structure of the social group in OAE allows individuals to interact in a unique way that is intended to lead to the achievement of personal and group goals. Many of these goals are only possible because of the small group structure. Research in the OAE field has shown this structure has the ability to produce important social outcomes such as social competence, cooperation, communication, relationship development, community, and teamwork (Allison & Von Wald, 2010; Anderson, Schleien, McAvoy, Lais & Seligmann, 1997; Goldenberg & Soule, 2011; Hattie, Marsh, Neil, & Richards, 1997; McAvoy, Smith & Rynders, 2006; Tucker, 1999). Goldenberg

and Soule (2011) found that the most salient parts of a student's course included developing relationships, building community, and creating opportunities for teamwork, even years after the experience. Sammet (2010) found that the development of authentic relationships was crucial to deter relational aggression in a sample of ethnically and socioeconomically diverse females. Others have found that relationships and the development of trust with instructors have had an effect on the social aspects of OAE courses (Brown, 2002; Shooter, Paisley & Sibthorp, 2010). The ability for the instructor to provide personal affirmations has also been considered a foundation to building healthy connections (Mitten, 1995). Developing connections with others is a critical component for adolescents in OAE programs; however, little is known about how these connections develop on OAE courses.

Outdoor adventure education programs are comprised of multiple components that interact with one another and lead to the emergence of particular outcomes (McKenzie, 2000; Walsh & Golins, 1976). Some of the main components in OAE programs include the natural environment, activities, the goals of the program, and the small group structure. The numerous components that exist in OAE courses make it difficult to suggest outcomes are a result of single variable effects. Ewert and Sibthorp (2009) argue that one of the challenges in OAE research are the many confounding variables that can influence the effects found in studies. In addition, research in OAE does not occur in a laboratory, and therefore using controls in a study is difficult or often not possible. The traditional research paradigm and statistical methodologies use a reductionist approach and may be unable to capture the complexities of OAE experiences. Furthermore, many researchers have previously advocated for a better

understanding of the OAE process, as opposed to just focusing on student outcomes (Hattie et al., 1997; McKenzie, 2000). One theoretical framework that may be useful to handle the complexities in OAE research is dynamical systems theory (DST).

Dynamical systems theory is a theoretical framework that recognizes the complex interactions between multicomponent systems and seeks to explain the temporal patterning of such systems (Howe & Lewis, 2005). The focus of DST is not to explain cause-effect relationships; rather it uses mathematical equations to describe the qualitative changes of a system (Thelen & Smith, 2006). The notions of systems thinking have a long interdisciplinary tradition and were formalized with Bertalanffy's general systems theory, however, DST and this dissertation follow the tradition of systems formulated by Haken's (1983) notions of synergetics.

The following dissertation is comprised of five chapters that seek to better understand how adolescents develop social connections within the context of OAE programs. First, the variables that may be related to the development of social connections were investigated. Second, to take on the complexities of research in the OAE context, the theoretical foundations and methodological considerations of DST are introduced. Third, a study which uses a DST framework and modeling technique is used to further understand the development of social connections. Finally, a concluding chapter discusses how Chapters 2, 3, and 4 relate and build from one another toward a better understanding of social connections in OAE research. The following is a brief description of each chapter.

Chapter 2 of this dissertation is entitled "The Adolescent Social Group in Outdoor Adventure Education: Social Connections that Matter." This chapter was a study

conducted in the summer of 2013 to assess particular individual level, group level, and time level variables on the connections students had with one another. Data were collected from 22 groups who participated in a 30-day backpacking course with the National Outdoor Leadership School (NOLS). Questionnaires and social network analysis data were collected at approximately days 10, 20, and 30 (end) of the course. A multilevel statistical model was used to assess these relationships.

Using a multidimensional group-identification framework to operationalize "connection," particular individual-level and group-level variables were related to how students connected with one another. The affective dimension of group identification showed two significant individual-level predictors (goal conflict and social status) and two significant group-level predictors (leadership consideration and sex ratio). The cognitive dimension of group identification showed two significant individual-level predictors (goal conflict and social status) but not any significant group-level predictors. Time was not a significant predictor in the model. Perhaps more importantly, the effect sizes for each model were small. For the affective dimension, 82% of the variance was at the individual level, but only 8% was explained by the model. For the cognitive dimension, 94% of the variance was at the individual level and only 16% was explained by this model. These results suggest that there are many aspects within the social system that contribute toward developing social connections that were not accounted for or tested. To take on these complexities, a different approach is needed that holds different assumptions than classical methodologies and reframes the way in which phenomena are viewed. The use of a DST approach may be one way this could be done.

Chapter 3, titled "Using Dynamical Systems Theory in Outdoor Adventure

Education Research", is a theoretical and methodological paper that explains the foundations, assumptions, and terms used to describe dynamical systems in relation to an illustrative OAE social scenario. To situate the theoretical aspects of DST, data from two spring-semester NOLS courses were collected in 2015. The variables under study were similar to those from Chapter 2, but adjusted to align with DST. First, the construct of sense of belonging was used to operationalize social connection and was measured in relation to goal conflict and instructor support. These data are used as an exemplar of one way to analyze DST data. The literature in OAE does not currently have any research that statistically models dynamical systems. This chapter describes and shows the use of a "change as outcome" model using multilevel modeling techniques. A description of how to set up the data, analyze the data, and how to interpret the results are presented.

Chapter 4 of this dissertation, "Understanding the Dynamical Nature of Social Connections for Adolescents in Recreation Programs" is a study integrating what was learned from Chapters 2 and 3. Using DST as a theoretical and methodological framework, data were collected during the summer of 2015 with NOLS from six groups of 10-15 adolescent students ($n = 63$). In order to provide a better DST analysis and assessment of change, data were collected every day for the 12 full days students were in the field. The same variables that were studied in Chapter 3 were used in Chapter 4. Furthermore, the change as outcome statistical model that was introduced in Chapter 3 is used in Chapter 4 as the primary analysis technique.

The purpose of this study was twofold. First, we were trying to capture an understanding of how the system moves toward a stable pattern over time. Second, we

are trying to understand the influence of particular control parameters within the system once it has settled into stable patterns. This differentiation between the two is important because perturbations will have different influences on a system, depending on whether it has become stable or not. For example, a system that is still developing into a stable pattern will be much more sensitive to perturbations than a system that is already stable.

The findings of Chapter 4 suggest a stable pattern, known as a fixed point attractor, exists within these data. The set point and rate of change of this attractor are identified and discussed in relation to the three control parameters that were modeled. Process conflict had a significant interaction with the current level of sense of belonging which made the attractor stronger (more stable and increased the rate at which students moved toward the attractor). Goal conflict was not a significant control parameter within this system, but contributed to the perturbations of the system. The third control parameter, instructor support, showed a significant positive main effect but not a significant interaction. This main effect suggests that the set point of the attractor increases when students have higher levels of instructor support. This particular DST model was able to account for 29% of the variance in these data. The findings are discussed in relation to the current OAE literature.

Chapter 5 of this dissertation provides a conclusion and linkage between the previous four chapters. The social system in OAE is inherently complex and multifaceted. Chapter 2 of the dissertation focused on identifying the main components within the system that were related to social connection. The findings of this study revealed particular components that were related to social connection and the need for better measurement timing. A different theoretical and methodological lens was used to

take on the challenges of studying the complexity of the social system in OAE. The theoretical and methodological foundations of DST were presented and used as the groundwork for Chapter 4. A DST conceptualization allowed for a better understanding of change and required a different way of understanding phenomena than the traditional paradigm. One way to move the understanding of OAE forward may be through the use of a DST perspective.

References

Allison, P., & Von Wald, K. (2010). Exploring values and personal and social development: Learning through expeditions. *Pastoral Care in Education*, *28*(3), 219-233.

Anderson, L., Schleien, S.J., McAvoy, L., Lais, G., & Seligmann. (1997). Creating positive change through an integrated outdoor adventure program. *Therapeutic Recreation Journal, 31*(4), 214-229.

Brown, M. (2002). The facilitator as gatekeeper: A critical analysis of social order in facilitation sessions. *Journal of Adventure Education and Outdoor Learning, 2*(2), 101-112.

Ewert, A., & Sibthorp, J. (2009). Creating outcomes through experiential education: The challenge of confounding variables. *Journal of Experiential Education, 31*(3), 376-389.

Goldenberg, M., & Soule, K. (2011). How group experience affects outcomes from NOLS programs: A means end analysis. *Journal of Experiential Education, 33*(4), 393-397.

Goossens, L. (2006). Affect, emotion, and loneliness in adolescence. In S. Jackson & L. Goossens (Eds.), *Handbook of adolescent development* (pp. 51-70). New York, NY: Psychology Press.

Haken, H. (1983). *Synergetics: An introduction: Non equilibrium phase transitions and self-organization in physics, chemistry*. New York, NY: Springer.

Hattie, J., Marsh, H.W., Neill, J.T., & Richards, G.E. (1997). Adventure education and outward bound: Out-of-class experiences that have a lasting effect. *Review of Educational Research, 67*(1), 43-87.

Horn, S. (2011). Group status, group bias, and adolescents' reasoning about the treatment of others in school contexts. In M. Killen & R.J. Coplan (Eds.), *Social development in childhood and adolescence: A contemporary reader* (pp. 184-199). Malden, MA: Wiley-Blackwell.

Howe, M.L., & Lewis, M.D. (2005). The importance of dynamic systems approaches to understanding development. *Developmental Review, 25*, 247-251.

McAvoy, L., Smith, J.G., & Rynders, J.E. (2006). Outdoor adventure programming for individuals with cognitive disabilities who present serious accommodation challenges. *Therapeutic Recreation Journal, 40*(3), 182-199.

McKenzie, M.D. (2000). How are adventure education program outcomes achieved?: A review of the literature. *Australian Journal of Outdoor Education, 5*(1), 19-28.

Mitten, D. (1995). Building the group: Using personal affirming to create healthy group process. *Journal of Experiential Education, 18*(2), 82-90.

Lerner, R.H. (2002). *Adolescence: Development, diversity, context, and application*. Upper Saddle River, NJ: Prentice Hall.

Sammet, K. (2010). Relationships matter: Adolescent girls and relationship development in adventure education. *Journal of Experiential Education, 33*(2), 151-165.

Shooter, W., Paisley, K., & Sibthorp, J. (2010). Trust development in outdoor leadership. *Journal of Experiential Education, 33*(3), 189-207.

Thelen, E., & Smith, L.B. (2006). Dynamic systems theories. In M. Damon & R.M. Lerner (Eds.), *Handbook of child psychology* (pp. 258-312). Hoboken, NJ: Wiley & Sons.

Tucker, A. R. (2009). Adventure-based group therapy to promote social skills in adolescents. *Social Work with Groups*, *32*(4), 315-329.

Walsh, V., & Golins, G. L. (1976). *The exploration of the Outward Bound process.* Denver, CO: Colorado Outward Bound School.

CHAPTER 2

THE ADOLESCENT SOCIAL GROUP IN OUTDOOR ADVENTURE EDUCATION: SOCIAL CONNECTIONS THAT MATTER

Abstract

Outdoor adventure education (OAE) experiences provide a unique context for adolescents to make social connections with other students. The social group plays an important role in the experiences adolescent students have and the challenges groups are able to overcome. Using a group identification framework, this paper investigated how 237 students from 22 different courses from the National Outdoor Leadership School (NOLS) connected with their peers. The specific components modeled include goal conflict, leadership consideration, social status, and demographics. The results suggest that goal conflict with other students, social status, leadership consideration and sex ratio were significantly related to the two dimensions of group identification. The social group remains an important component to all OAE programs but needs further research to highlight the intricacies that are involved in developing social connections within group settings.

Introduction

Outdoor adventure education (OAE) offers a distinct environment where students are able to develop and learn. One of the main components of OAE experiences is the social group (cf Walsh & Golins, 1976). Most OAE programs take a small group of individuals (usually between ten and fifteen) who do not have a common history and have them engage in activities that require support, teamwork, and communication over an extended period of time. This sudden transition into an isolated social group can be very challenging, in particular for adolescents, who have not spent much time away from home or who have not been required to interact with others outside of their "friendship" network. There has been a plethora of research that has supported the significance the social group has on student experience and learning (Ewert & McAvoy, 2000; McKenzie, 2000; Sibthorp, Paisley, & Gookin, 2007), however, few studies have attempted to parse this critical aspect of OAE into more helpful parts and pieces.

Interpersonal relationships with peers are a central focus for youth navigating the uncertainty of adolescence (Scholte & Van Aken, 2006). Social relationships have the ability to strengthen, solidify, and complement an adolescent's development and understanding of self (Pugh & Hart, 1999). However, the development of interpersonal relationships is not always easy for adolescents because of the biological, psychological, and social changes they are experiencing. If not fostered appropriately, social relationships can be developmentally detrimental and have long-lasting negative impacts (Pugh & Hart, 1999).

Negative experiences and group processes may ensue if students do not socially connect with one another on OAE courses. The consequences of not having this

connection can generate feelings of isolation and abandonment. These types of emotions can have devastating effects on adolescents, especially due to the fact that their peer group is such an important social milieu (Windle, 1994). Given the unfamiliar physical environment and challenging technical tasks for students, a well-connected social group allows students to attain the self-esteem and efficacy needed to complete the common challenges on OAE courses.

Practitioners of OAE often discuss the importance of group processes, group stages, and social norms as portions of outdoor leadership theory (cf Martin, Cashel, Wagstaff, & Breunig, 2006). However, little research has explicitly attempted to dissect the social group into parts that may be proactively addressed by programmers and instructors. Using the social system model created by Sibthorp and Jostad (2014) as a framework, the purpose of this study was to examine some of the more likely components of the social group that lead to stronger social connections between students on OAE courses. Specifically, this model posits that group-dependent outcomes (social connections) are influenced by components including goals (goal conflict), the role of instructors or leaders (leadership consideration), student or participant factors (demographics), group factors (social status within the group), and time (duration of the course).

Social Connection

There are many ways to conceptualize the social connections within a group. While social cohesion has been popular in OAE studies (Eys, Ritchie, Little, Slade, & Oddson, 2008; Glass & Benshoff, 2002), the broader literature has gravitated toward sense of community (McMillan & Chaviz, 1986), relatedness (Deci & Ryan, 2002),

belongingness (Baumeister & Leary, 1995; Van Ryzin, Gravely, & Roseth, 2009), and group identification (Hogg & Hains, 1998). While each of these constructs is nuanced, they all, fundamentally, tap aspects of the social connections in a group or setting. Due to the nature of OAE and the importance of social connections for adolescents, we chose to operationalize social connections within a group identification framework.

Group identification is a complex, multidimensional construct that integrates multiple theoretical bases. One of the most common theoretical bases stems from the theory of social identity proposed by Tajfel (1981), who defines social identification as "that part of an individual's self-concept which derives from his knowledge of his membership in a social group together with the value and emotional significance attached to that group membership" (p. 255). The terms social identification and group identification are often used interchangeably, because an individual's social identification is related to the others around him or her.

Historically, group identification has been theorized as a multidimensional construct. Two dimensions that have been consistent throughout the literature have been the cognitive and affective dimensions. For the purposes of this study, the cognitive and affective dimensions of group identification were the focus because of the importance these dimensions have for adolescents.

Cognitive Dimension

The cognitive dimension of group identification stems from the social identity literature and self-categorization theory, which suggests that individuals define themselves within social categories (Jackson, 2002). This definition is based on the attributes one shares with others and is often represented as a dichotomous in-group

versus out-group relationship. That is, individuals cognitively view themselves as part of the group or not part of the group based on certain attributes. Though this dimension is often viewed as a dichotomous variable, group identification measures are conceptualized as a continuous variable (Henry, Arrow, & Carini, 1999).

Oakes, Haslam, and Turner (1994) suggest categorization is a "dynamic, context dependent process, determined by comparative relations within a given context" (p. 95). First, this view suggests that categorization changes over time and depends on the context of the social situation. Second, the attributes that may be used by an individual to develop this identity can vary. For example, students may base their cognitive identity by their sex, by the sports they play, or by the geographic region in which they live. However, physical attributes are one of the most common means by which individuals categorize themselves (Harrison, Price, & Bell, 1998). Research has shown that these surface level attributes, such as demographics (e.g., age, race, sex), may be important initially but become less influential over time, whereas deep-level attributes (not easily observed characteristics such as attitudes, beliefs, and values) become more influential over time (Harrison et al., 1998).

While the cognitive dimension plays a prominent role in identification, it is not sufficient to explain all aspects of identification (Deaux, 1996). Even in Tajfel's original definition, he recognized an emotional or affective component. He also argued that social categories were not neutral, but included affective meanings that were central to understanding identification. Therefore, another critical dimension of group identification is the affective dimension.

Affective Dimension

The affective dimension of group identification has seen less empirical work than the cognitive dimension, which Jackson (2002) suggests is an "area ripe for investigation and may be an especially pivotal aspect of group identity" (p. 29). This dimension stems from the group cohesion literature and is most often conceptualized as the interpersonal attraction of the individual to others in the group. Although there are a number of different ways in which group cohesion has been operationalized in the literature, attraction toward others was one of the original formulations and continues to be one of the most consistent (Carron & Brawley, 2000). Jackson (2002) defines this component as "being satisfied with group membership and feeling a sense of commitment to the group or belongingness" (p. 16). Therefore, one component needed for individuals to identify with others in the group is to have and create affective bonds and interpersonal relationships with others.

Predictors of Social Connection

Based on the theoretical foundations of group identification and the complexity of social processes in small groups, predictor variables were chosen based on a social system model in OAE. Sibthorp and Jostad (2014) developed a social system model based on the extant small group and OAE literature. This model recognizes the complexity and dynamical nature of the social system within OAE by identifying the main components of this system and how they may interact with one another. For the purposes of this study, the components of goals, students, instructors, and time were used as the main predictors. Within each of these components, the specific variables chosen

were based on the theoretical foundations of both group identification and the particular component.

Goal Conflict

A condition that can stymie the integration of students in the social group is goal conflict. Goal conflict has been shown to exist in three different forms (Slocum, Cron, & Brown, 2002). One type occurs when an external goal is imposed on a personal goal. A second type occurs when people are asked to achieve multiple goals when performing a single task. Third, goal conflict can develop when there are tradeoffs between several types of tasks or outcomes when multiple goals exist. In OAE, goal conflict often manifests itself when students do not have the same goals as the other students in the group or with the organization. The goals students have for participating in OAE courses can vary dramatically and/or not be clearly articulated (Crane, Hattie, & Houghton, 1997). Some students may want to focus on the development of technical skills whereas others may be driven by intrapersonal development. The instructors are hired to deliver the goals of the program. Therefore, instructor goals often align with programmatic goals, but instructors may have some flexibility in how they implement these goals. The types of goals students and instructors have can influence their interactions, and thus, their group identification.

When goals align between individuals in small groups it has been shown to provide commitment, cohesiveness, and conflict resolution (Hackman & Katz, 2010). That is, individuals are more likely to have stronger interpersonal relationships because they share the same vision. Goals have the potential to influence an individual's affect, which is often most influenced by the facilitation or difficulty in achieving one's goals

(Emmons & Kaiser, 1996). Seijts and Latham (2006) showed that alignment between individual and group goals led to higher levels of performance on the task. Therefore, the cognitive and affective dimensions of group identification may be influenced if students have different goals than others in the group, including both peers and leaders. Instructors, however, also hold a number of other roles in OAE. One of these central to the group is the level of consideration, or concern, a leader has for the students.

Leadership Consideration

Leadership consideration refers to the ability of the leader to maintain close relationships with students that are characterized by concern, respect, and the expression of appreciation and support for students (Judge, Piccolo, & Ilies, 2004). This person-centered leadership approach should lead to stronger social connections between students and the leader (Yukl, 2006). Judge et al. (2004) provided a comprehensive meta-analysis that showed consideration was a stronger predictor of member satisfaction. When individuals are able to respect, appreciate, and feel support from their leader, the ability to identify with that leader and other members becomes easier.

The relationship between the instructor and the student has received relatively little attention in OAE even though the impact and importance seems clear. The extant literature strongly supports that positive interpersonal relationships between leaders and followers builds trust, solidarity, and commitment (Yukl, 2006). However, the importance of relationship building between student and instructor is lacking in the literature and needs further empirical evidence in OAE. Individual differences can play an important role in how students interact with one another and are often reflected by student demographics.

Demographics

Students bring a host of characteristics and attributes that may influence how they are able to identify with others in the group. Tubbs (2012) posits that all group interaction starts from these "background" factors that each individual brings, which include personality, sex, age, health, attitudes, and values. In naturally occurring groups, many of these factors may easily align between individuals because people tend to socialize most often with others who have similar personalities, attitudes, and values. This alignment may also happen in organizational or sports team environments because people are hired or have been selected for the team based on particular skills or experience. While commonalities in attitudes and values may exist (e.g., an affinity for the outdoors), students on OAE courses often have no prior experience with one another.

Sex

One of the common demographics in OAE is the sex of students. Sex is a variable that plays a key role on OAE courses and has the potential to influence the development of identity. Females tend to be a minority on OAE courses but have also been shown to possess stronger social motivations than males (Ewert, Gilbertson, Luo, & Voight, 2013). Females and males have been shown to form single-sex social cliques (Jostad, Paisley, Sibthorp, & Gookin, 2013); however, this may be a result of the ratio of females and the inherent structural properties of OAE courses (e.g., single sex tent groups). There is not previous research in OAE that has looked at the sex ratio of groups, and the influence of sex on the ability of students to identify with one another may provide an important understanding of this element of social group development.

Socioeconomic Status

Another demographic variable of interest is socioeconomic status, which has seen little research and warrants more attention as the demographics of our country change (Warren, Roberts, Breunig, & Alvarez, 2014) and if OAE is considered a space of privilege (Rose & Paisley, 2012). One way in which to break down the economic barriers that prevent many adolescents from participating in such experiences is to provide scholarships. Students who receive these scholarships most often come from inner city environments and have had little wilderness experience. However, as Rose and Paisley (2012) note, "providing scholarships to marginalized students, for example, may only provide a venue change for the same patterns of privilege and power to manifest rather than tilting the systems that made such access unattainable or appealing" (p. 149). In order to "tilt the system", OAE programs have directed resources toward instructor education about inclusion and diversity, in addition to varying the number of students receiving scholarship on courses in order to see how having "similar peers" influences their experience. Paisley et al. (2014) found that differences in the number of students receiving scholarship in a group greatly influenced the experience these students had on OAE courses. Socioeconomic status plays a large role in the accessibility of such experiences, but there is still much to learn about the influence this may have on the social system of OAE courses. Despite the differences that may exist between individuals, the relationships that form between students and the resulting social status this creates may provide even more information about how students connect with one another.

Social Status

Relationships within a group of students can be understood via their relative status within the group. As groups develop and students interact with one another, a social hierarchy emerges and differentiates members of the group based on status (Forsyth, 2010). Fundamentally, status is derived from salient personal characteristics that others in the group believe are important (Jacob & Carron, 1998). We were specifically interested in a peer-nominated measure of social status to preclude the inherent problems with self-report instruments, where students might hold inaccurate self-perceptions of their social status within the group. Status, the way we are defining it, is based sociometrically on the number of times a student was chosen, or nominated, by another student based on a social scenario. When students choose the group members they would prefer to spend time with, those that hold more social status within the group become apparent. If a student holds more status within the group, it stands to reason that they concomitantly have a higher level of group identification than those with fewer nominations. As Anderson, Kraus, Galinsky, and Keltner (2012) suggest, "as a reflection of respect and admiration among peers, sociometric status is likely to strongly influence the personal sense of power and feelings of social acceptance" (p. 765). Others have looked at groups in the wilderness context and found that individuals had lower feelings of social cohesion when perceived by others as having less status (Eys et al., 2008). Status is not concrete, but rather, may fluctuate throughout the length of the course.

Time

While many aspects of an OAE experience contribute to how and why students feel a sense of connection to their group, we also know that this process is dynamic and

changes over time. Many of the common models of group formation (e.g., Tuckman & Jenson, 1977) account for stages or shifts in structure as a group progresses from a combination of individuals to some semblance of a group.

Time is a critical component to all OAE programs. Depending on the organization and context, OAE experiences can range from a single day to a multiweek or even multimonth experience. While most studies use a pre-post research design, this provides little insight into the dynamic nature of OAE courses. Hattie, Marsh, Neill, and Richards (1997) showed that longer courses have a stronger effect than shorter courses for students, however, more longitudinal research is needed in our field to understand the developmental processes and mechanisms of phenomena central to OAE (Ewert & McAvoy, 2000).

Little longitudinal research has been conducted on group identification, but it is recognized that this identification is dynamic: "Identifications are neither carved in stone nor locked in neural networks. From one situation to the next, the salience of any particular identification can shift; from one period to another, major alterations in identity patterns can occur" (Deaux, 1996, p. 792). The development of an identity with others in a group should naturally increase over time. However, the rate at which these identifications develop is relatively unknown. There are many facets that contribute to the way a student identifies with others in the group. This research attempts to identify the factors that are most salient to the development of group identification and to understand the influence these factors have on students who participate in OAE courses.

Methods

Participants

During the summer of 2013, data were collected from 237 students on 22 courses participating in 30-day backpacking expeditions in the Rocky Mountains with the National Outdoor Leadership School (NOLS). The mean age of students was 17.1 years; 65% of the sample was comprised of males, and 35% females. Groups varied in composition in regard to the number of male and female students and the number of students who received scholarships. Six courses did not have any students receiving scholarships, two of which were all-male courses. Fourteen of the courses were mixed courses (consisting of both students receiving and not receiving scholarships), and had 1-9 females and 1-3 students receiving scholarships per course. The final two courses consisted of all students receiving scholarship. As only 12 of the students were over the age of 19 years and all were under the age of 23 years, they were all considered adolescents for purposes of this study.

The courses were typical backcountry OAE courses where students learn outdoor living skills, backcountry navigation and route-finding skills, environmental studies, risk management, and leadership skills. Due to the logistical challenges of collecting longitudinal data in the field, data were collected during two re-rations (approximately days 10 and 20) and on the final day of the expedition (day 30). All questionnaires were administered by the instructors of the course and students were ensured their responses would be confidential. Students were asked to find space away from others while completing the questionnaires and not to share their responses with others. All data were removed from the field by the re-ration team immediately following each administration.

Instruments

The affective and cognitive sources of group identification were measured using The Group Identification Scale (Henry et al., 1999). Four items were used to represent the affective dimension while two items were used to represent the cognitive dimension. Goal conflict was measured with two items written by the authors, which stated "I want different things from this course than other people in this group" and "I want different things from this course than my instructors want for me". Leadership consideration was measured using a 4-item subscale of the Leader Behavior Description Questionnaire (LBDQ-XII; Stogdill, 1963). All items were based on a 5-point Likert-type scale from "strongly disagree" to "strongly agree" (see Appendix for all items).

In this study, socioeconomic status was represented by students who received scholarships. Ratios of sex and scholarship status were computed to assess group-level effects on identification. The sex ratio was operationalized as the ratio of females per course and the scholarship ratio was operationalized as the ratio of students receiving scholarship per course. Some students who received scholarships were in mixed courses while others were in all-scholarship courses. Furthermore, there were also courses that did not have any students receiving scholarships.

Social network analysis protocols (see Jostad, Sibthorp, & Paisley, 2013) provided the peer-nominated indicator of social status. These data were collected by asking students to choose three members of their group they would prefer to be with based on a backcountry social scenario, which specifically stated:

> You are preparing to do an easy day of travel without instructors. The route is only a few miles on-trail and the weather will be excellent. You will be camping near a lake and should have plenty of time to hang out and enjoy each other's company. Name up to three students you would want in your group.

Analysis

Multilevel modeling was used because of the nested design of the data (Raudenbush & Bryk, 2002). A 3-level model was developed using the statistical package Hierarchical Linear Modeling (HLM) and included time at level 1, student at level 2, and group at level 3 for both dependent variables; however, in the initial run of the model, the affective and cognitive dimensions did not significantly change over time. Because our findings did not vary across time intervals, time was removed from the model. A revised 2-level model was developed for hypothesis testing that included students at level 1 and groups at level 2 based solely on the final administration (end of the course) of the instruments. Group identification was tested for the following relationships (the term group identification is used here to represent both the affective and cognitive dimensions):

- Group identification will be negatively related to goal conflict and positively related to leadership consideration, and social status.
- Group identification will be different for females than males and be positively related to the sex ratio (proportion of female students per course).
- Cognitive identification will be positively related to the scholarship ratio (proportion of students receiving scholarship per course) for students who are receiving scholarships.
- Students receiving scholarship in a group with all students receiving scholarship will have a higher level of cognitive identification than students receiving scholarship from a mixed scholarship group.

Results

Prior to hypothesis testing, basic psychometrics were run for the measures. Using Cronbach's alpha, the reliability was acceptable for the affective ($\alpha = 0.74$) and cognitive ($\alpha = 0.72$) domains. Leadership consideration initially had an unacceptable reliability ($\alpha = 0.60$). After reviewing one question that was causing the reliability to be low, the authors determined the wording was vague and could have led to misinterpretation. Therefore, this question was removed from the subscale score, which then provided an acceptable reliability ($\alpha = .72$). Goal conflict with other students and instructors was assessed with single items.

Affective Dimension

The first step in the analysis of a multilevel model is to run the null model to obtain the Intraclass Correlation Coefficient (ICC) in order to see the variance distribution between levels. The ICC for the affective (AFF) dimension was 0.18, which shows that 18% of the variance was attributable to course differences. The level-1 predictors that were group-mean centered were goal conflict with others (GCO) and instructors (GCI), and sex. The level-2 predictor, leadership consideration (LC), was grand-mean centered. Social status nominations (SSN) at level 1 and sex ratio (SEXR) and scholarship ratio (SCHR) at level 2 were not centered because they have a meaningful value of zero.

For the level-1predictors, the results suggest that goal conflict with others had a significant negative relationship ($\beta = -0.11$; $p < .001$) and social status had a significant positive relationship ($\beta = 0.03$; $p = .016$) with the affective dimension. That is, group identification decreased the more goal conflict students had with one another, and group

identification increased the more social status nominations students received. More specifically, students affectively identified with others in their group 0.11 units less when they were 1 unit above the group mean of goal conflict with other students. In addition, students identified 0.03 units more for every unit (nomination) they were from zero nominations. Goal conflict with instructors and the sex of a student were not significant predictors.

For the level-2 predictors, the results suggest that there was a significant positive relationship with leadership consideration ($\beta = 0.34$; $p = .05$) and sex ratio ($\beta = 0.40$; $p < .01$). That is, group identification increased for students when their group had more leadership consideration and when the ratio of females in the group was higher. More specifically, students identified with others 0.33 units higher when their group was a unit above the grand mean of leadership consideration. Furthermore, students identified with others 0.64 units higher when the ratio of females in the group increased every unit from zero. The scholarship ratio on courses was not a significant predictor of the affective dimension. See Table 2.1 for all test statistics.

The effect size for the model was computed using the variance components of the null model and predicted model with the equation: null model – predicted model/null model. The effect size of the level-1 model was 0.08 and the level-2 model was 0.39. That is, the level-1 predictors explained 8% of the variance at level 1 and the level-2 predictors explained 39% of the variance at level 2.

Cognitive Dimension

A 2-level model was also developed with the final administration to assess the cognitive (COG) dimension of group identification. The ICC was computed to assess the

variance between levels 1 and 2 and resulted in an ICC of 0.06. This result shows that 6% of the variance was at level 2 and 94% of the variance was at level 1. The same predictors were used in this model.

The results suggest that there were two significant level-1 predictors. Goal conflict with others was negatively related to identification ($\beta = -0.30$; $p < .001$) and social status was positively related ($\beta = 0.04$; $p = .05$). That is, group identification decreased when goal conflict increased and group identification increased when social status increased. More specifically, the cognitive dimension of identification decreased by .30 units for every unit the student is above the group mean in goal conflict. Furthermore, identification increased 0.04 units for every unit increase of social nominations. Goal conflict with instructors and sex were not significant at level one. No level-2 variables were significant. See Table 2.2 for all test statistics.

The effect size for this model was computed using the same equation as above. Because there was such little variance and no significant predictors at level 2, no effect size was computed for this level. The effect size of the level-1 model was .16 and suggests that these predictors explain 16% of the variance at level 1 of the model.

Because the cognitive domain is based on the notion of self-categorization, of interest was whether students who received scholarships identified with others in their group differently depending on the number of other students receiving scholarship in their group (scholarship ratio) and the composition (mixed or all students receiving scholarship) of their group. That is, we expected to find higher levels of cognitive identification for students on scholarship when the scholarship ratio of their group was higher. We tested a cross-level interaction between scholarship student and scholarship

ratio but did not detect a relationship. Reasoning that there would be a difference between students receiving scholarship on mixed courses and all-scholarship courses and to assess whether this may have changed over time, a 2 (group) x 3 (time) MIXED ANOVA was conducted. The group x time interaction was significant ($F_{(1, 42)} = 6.17$; $p = .05$). Post hoc tests suggest that students who were in a group with all students receiving scholarship had higher levels of cognitive identification at time 1 (day 10) than the mixed group, but that this difference diminished as the course progressed. Using Cohen's d, a large effect size ($d = 0.77$) was found at time 1.

Discussion

The purpose of this research was to better understand how some components of the social group are related to the development of social connections in OAE. Specifically, we modeled goal conflict, leadership consideration, student demographics, social status, and time to represent the components of the social system on OAE courses (cf. Sibthorp & Jostad, 2014).

Goal Conflict

Goals are often the foundation of educational institutions and group formation. You often see goals written like this: *When students have completed the course, they should be able to (fill in the blank).* While this structure of goals is common among program administrators and instructors, students often do not enter a program with this goal structure in mind.

Administrators and instructors need to provide a clear and concise objective for their program. If students are unaware of what they should be learning and how the experience should help them, then their goals may conflict with those of the program.

Programs should also be wary of proclaiming numerous outcomes for students. Students seeking solitude and time to connect with nature may be disappointed when course time is dedicated to learning technical skills or building a cohesive expedition team. Though in this study conflict was not found between students and instructors, we saw that goal conflict between students limited how they were able to connect with other students.

There are many possible reasons why students may attend an OAE course. Some students participate in OAE courses to learn new technical skills, develop leadership skills, or simply meet new friends. With the plethora of outcomes that are possible for students to achieve on OAE courses, it is not surprising that students may have conflict with one another based on these differing motivations. The link between goal conflict and social connectedness is limited. However, some have looked at goal conflict and psychological well-being and have shown that goal conflict is associated with negative affect (Boudreaux & Ozer, 2013). The only study we found that looked explicitly at goal setting in the OAE realm found that students tended to have vague goals; however, when students had similar goals as one another, they were shown to be more successful (Crane et al., 1997).

This research showed that students developed less social connectedness with others when goal conflict existed. Therefore, instructors should communicate with their students about student goals consistently throughout the course. If students do not have specific goals, or have goals that are not attainable, then these goals should be modified by the instructor and student. Depending on the program, it may also be helpful for students to share their goals with other students. If students are more aware of other student goals, they may try to help these students and possibly even embody these goals.

Lastly, instructors can also emphasize group goals. Even if students have different personal goals, they can share a common group goal that links every student toward a common objective.

These findings on goal conflict contribute to the OAE and small group literature in two specific ways. First, this research demonstrates the importance of providing clear goals for a course and encouraging students to articulate their own personal goals. Additionally, this study expands the research on goal conflict by showing that members with discordant goals can be the sources of goal conflict. Most goal-conflict research up to this point has focused on intrapersonal conflict.

Leadership Consideration

The necessity and importance of interpersonal leadership skills is well known (Martin et al., 2006); however, these skills are often not given as much attention in the OAE literature as leadership competencies in areas such as risk management, decision-making, technical skills, or teaching skills. The outdoor instructor is required to be a "jack of all trades", but the importance of how their relationships with students influence student outcomes has seen little attention. These findings suggest that the connection students make with their instructor is important and influences how they affectively respond.

This research found that the more the group felt their instructors exuded considerate behaviors, the more individuals felt affect toward other members in the group. Schumann, Paisley, Sibthorp, and Gookin (2009) identified both instructor behaviors and traits that impacted student learning on NOLS courses. One of the important characteristics noted was empathy, which they identified as the "instructors"

ability to listen to their [students] concerns and make them feel validated and understood" (p. 22). Other categories that relate to these findings include role modeling and creating a supportive learning environment. One possible reason for this finding may stem from the role-modeling behaviors that are essential for OAE instructors (McKenzie, 2003). When students see and feel their instructor show appreciation and support, they may be more likely to replicate these actions toward others, which in turn can lead to a greater affective state for individuals. A number of studies in OAE have shown that students are more successful when more social support is provided by their instructors (Draper, Lund, & Fisher, 2011; Sibthorp, Furman, Paisley, Gookin, & Schumann, 2011).

Some instructors may be more inclined to exude considerate behaviors due to aspects of personality or enjoyment of the course. However, considerate behavior is something that can be learned and should be part of staff training for programs. Administrators can provide trainings that help instructors communicate, listen, and develop emotional intelligence. Instructors can become more considerate by checking in on their students on a daily basis or by sharing information about themselves to students. If instructors are working with students who are much younger, then it would be very helpful for the instructors to become familiar with the popular culture of that age group. This will help instructors relate to their students and have conversations that might be difficult otherwise.

Student Demographics

We chose to ask questions about gender and socioeconomic status due to the theoretical foundations of group identification, the population, and the need for a further understanding of the role socioeconomic status plays in OAE experiences.

Sex

Understanding differences between males and females is needed in OAE research (Norton & Watt, 2014). Males and females often differ in the importance placed on social aspects of an adventure experience. Ewert et al. (2013) found that females participating in adventure experiences were more socially oriented than males. Others have also suggested that females place more of an emphasis on the affective domain of identification because relationships are a primary motive (Deaux, 1996). The results from this study did not find a significant difference in either dimension based on sex and this aligns with the majority of OAE research (Hattie et al., 1997), although others have found greater gains in social competencies for males (Norton & Watt, 2014). One possible reason for this could be due to the unequal numbers of males and females on different courses. Some courses only had two female participants whereas others had between four and nine female participants. Because the students are adolescents, they often create groups and cliques according to their sex (Jostad et al., 2013). When groups have small numbers of females, it may be more difficult for them to identify with a majority male population. Instructors need to be cognizant that females and males may differ in the emphasis they place on the social aspect of the course. Single-sex groups or co-ed groups may need to be led differently because of these differences.

There has not been any research that has explicitly looked at the sex ratio of students on OAE courses outside of single-sex groups. As the ratio of females on a course increased, both male and female student affective identities increased. This result suggests that students will have higher levels of affective identification when there are more females in the group. However, most courses did not have a sex ratio above 0.5,

which suggests the relationship in these data only hold true until groups are approximately 50% male and 50% female. While these findings may lend some evidence for the value of a balanced ratio between males and females in the group, we did not have data of groups with predominately females. Administrators should consider the sex make-up of their courses and help instructors prepare for sex differences. The ratio of females and males is worth additional work given the limitation of our sample.

Socioeconomic Status

This study used scholarship status as a proxy for socioeconomic status. Even though the scholarship ratio was not significant in the affective dimension, we believed it was likely that students receiving scholarships would cognitively identify with others differently based on their group composition and that this would change over time. There was a significant difference between the two groups at day ten, but this difference declined and became nonsignificant as the course progressed. These findings align with what Harrison et al. (1998) suggested: students may identify with others early in the course based on "surface level" characteristics like gender and age, whereas this may decline over time and "deep level" characteristics like attitudes and values become more important.

The implications of these findings suggest that OAE may be a venue that can lower the barriers between adolescents of different socioeconomic status. Paisley et al. (2014) looked specifically at the differences among groups with three different compositions of students from lower socioeconomic backgrounds. These findings align with what they found, in that there was a strong "separation" between students from lower and higher socioeconomic status approximately one third of the way through the

course. While their study did not attempt to model the dynamic nature of social status, it does show that differences between students can be challenging to overcome immediately. Wright and Tolan (2009) also found that adventure activities can be used to teach students about diversity and reduce prejudice. In their qualitative study, some of the themes identified included the value of a diverse group, awareness of personal prejudice, and stereotype discontinuity.

Administrators and instructors need to be aware that it takes time to overcome these differences. In this study, it took approximately 3 weeks to see these changes, but some courses may not be long enough to provide this type of change. Furthermore, these findings demonstrate the importance of students learning about the internal aspects of other students, which can be facilitated by instructors through games, activities, journaling, and focused unstructured time that allow students to get to know one another on a more personal basis.

Social Status

The more social nominations students received from others in the group, the more they identified both affectively and cognitively. One of the fundamental aspects of developing positive affect is the formation of meaningful social bonds (Baumeister & Leary, 1995). Although these results only suggest that the number of nominations increase identification, these nominations may also be a product of meaningful relationships. Jostad et al. (2013) looked at reasons why students on OAE courses preferred to be with others in social situations. Based on the relationships at the end of the course, two of the three themes identified were: “connections with others” and “experienced best times with”. These results suggest that relationships at the end of the

course are based on the experiences, memories, and social and emotional connections students have with one another.

Status can be a product of many different characteristics of a person. We were specifically interested in social status, but recognize that status can result from a variety of characteristics, such as particular technical skills or experience. Instructors need to be aware of what the group emphasizes as important, since this is the foundation of what develops status. For example, if the group places a strong level of importance on physical ability, then status will develop around this characteristic. If this is not what status should be about in the group, then instructors need to encourage student thinking towards other positive aspects of status (e.g., expedition behavior) which may create a more inclusive environment.

Time

Though we theorized that the affective and cognitive dimensions of group identification would increase over time, our results showed that neither dimension was related to time. Considering that the timing of the measurements began at day 10, it may be possible that each dimension had already fully developed for individuals. This result suggests that instructors only have a limited amount of time before the social connectedness of the group forms. On shorter courses such as those lasting two weeks, this timing may be even shorter. The lack of change seen may also be due to the fact that administrations occurred during two re-ration points and at the end of the course. Food is a key commodity on OAE courses (Paisley et al., 2014) and re-rations are often a time of transition for students. Students are usually beginning to work with a different cook and tent group and may possibly be orienting their feelings toward others with whom they

have not yet had any conflict. This transition may have an influence on the feelings people have toward one another.

Identification with other individuals in a group is a dynamic construct (Deaux, 1996), but the timing of our measurements were not able to detect any change. When trying to model a changing system, scholars need to consider how the timing of their administrations may influence the results of the phenomena under study. For example, if the affective and cognitive domain were to develop rapidly at the beginning of group experiences and then stabilize over time, the true dynamics of the phenomena may be missed if the timing of measurement is not appropriate. Future research should consider administering measures a couple of days after the course begins. We recognize that the ability to collect multiple data points in the field is often extremely difficult and researchers are often happy to collect whatever data are available. In our case, the only feasible option to ensure we were able to retain all of the data was to collect it at a re-ration. However, it should also be of concern that the timing of measures corresponds well with the theoretical nature of the phenomena under study; otherwise the detection of appropriate changes will not occur.

Limitations

In addition to the issues related to the timing of the instrument completion, there were several other limitations that should be considered when interpreting these results. First, the research design is nonexperimental and the only conclusions that can be made are the associations between variables. Unfortunately, we cannot suggest any causation of why individuals identify with others differently, but the associations provide a starting point to consider future research. Second, our measures of student characteristics were

limited. Given the limited age range of our sample, age was not modeled and other student factors, such as personality or attitudes, were neither measured nor modeled. Third, we have little detail on the reasons behind some of the findings. For example, we do not know the nature of the goal conflicts reported with other students. While it is helpful to know that students may have conflicting goals with one another, it would also be helpful to understand the nature of this conflict. As this line of research advances, it would benefit from additional details on the nature of the variables thought to play a role in the OAE social group.

There are many factors within an individual and a group that influence how a student identifies with others. Though there were significant findings, the effect sizes for our level-1 models were small and suggest there was a large level of variance unexplained at the individual level.

Conclusion

The social group remains a critical aspect of OAE, and is especially salient to adolescents regardless of context. As we work to better tailor OAE programming for different populations and purposes, we need to better understand the processes that underpin this central phenomenon of OAE.

The OAE social group is different than many other social groups adolescents may encounter. The remote and cloistered nature of OAE exacerbates the importance and influence of the group. Although the types of challenges students encounter in these groups can provide a unique arena for positive social growth unattainable at home, negative social experiences can also ensue. Programs need to provide an environment

and structure that ensures the social group is an inclusive and positive experience for adolescents.

This research sought to further understand the important components within the social group that encourage social connections between students by testing a model of the social system. We found at least one variable from each component of the model to have a significant relationship to the development of social connections. These results show that this model may provide a viable explanation and description of the social system in OAE; however, further empirical evidence that uses different variables is strongly recommended.

References

Anderson, C., Kraus, M.W., Galinsky, A.D., & Keltner, D. (2012). The local ladder effect: Social status and subjective well-being. *Psychological Science, 23*(7), 764-771.

Baumeister, R. F., & Leary, M. (1995). The need to belong: Desire for interpersonal attachments as a fundamental human motivation. *Psychological Bulletin, 117*(3), 497-529.

Boudreaux, M.J., & Ozer, D.J. (2013). Goal conflict, goal striving, and psychological well-being. *Motivation and Emotion, 37*(3), 433-443.

Carron, A.V., & Brawley, L.R. (2000). Cohesion: Conceptual and measurement issues. *Small Group Research, 31*(1), 89-106.

Crane, D., Hattie, J., & Houghton, S. (1997). Goal setting and the adventure experience. *Australian Journal of Psychology*, *49*, 6-13.

Deaux, K. (1996). Social identification. In E.T. Higgins & A.W. Kruglanski (Eds.*), Social psychology: Handbook of basic principles* (pp. 777-798). New York, NY: The Guilford Press.

Deci, E. L., & Ryan, R. M. (2002). *Handbook of self-determination research.* Rochester, NY: University of Rochester Press.

Draper, C.E., Lund, C., & Flisher, A.J. (2011). A retrospective evaluation of wilderness-based leadership development program. *South African Journal of Psychology, 41*(4), 451-461.

Emmons, R. A., & Kaiser, H. A. (1996). Goal orientation and emotional well-being: Linking goals and affect through the self. In L.L. Martin & S. Tesser (Eds.), *Striving and feeling: Interactions among goals, affect, and self-regulation* (pp. 79-98). New York, NY: Psychology Press.

Ewert, A., Gilbertson, K., Luo, Y.C., & Voight, A. (2013). Beyond because it's there: Motivations for pursuing adventure recreational activities. *Journal of Leisure Research, 44*(1), 91-111.

Ewert, A., & McAvoy, L. (2000). The effects of wilderness settings on organized groups: A state of the knowledge paper. *USDA Forest Service Proceedings, 3*, 13-26.

Eys, M. A., Ritchie, S., Little, J., Slade, H., & Oddson, B. (2008). Leadership status congruency and cohesion in outdoor expedition groups. *Journal of Experiential Education, 30*(3), 78-94.

Forsyth, D. (2010). *Group dynamics* (5th ed.). Belmont, CA: Wadsworth, Cengage Learning.

Glass, J.S., & Benshoff, J.M. (2002). Facilitating group cohesion among adolescents through challenge course experiences. *Journal of Experiential Education, 25*(2), 268-277.

Hackman, J. R., & Katz, N. (2010). Group behavior and performance. In S.T. Fiske, D.T. Gilbert, & G. Lindzey (eds.), *Handbook of social psychology* (pp. 1208–1251). San Francisco, CA: John Wiley & Sons, Inc.

Harrison, D.A., Price, K.H., & Bell, M.P. (1998). Beyond relational demography: Time and the effects of surface- and deep-level diversity on work group cohesion. *Academy of Management Journal, 41*(1), 96-107.

Hattie, J., Marsh, H.W., Neill, J.T., & Richards, G.E. (1997). Adventure education and Outward Bound: Out-of-class experiences that have a lasting effect. *Review of Educational Research, 67*(1), 43-87.

Henry, K.B., Arrow, H., & Carini, B. (1999). A tripartite model of group identification: Theory and measurement. *Small Group Research, 30*(5), 558-581.

Hogg, M. A., & Hains, S. C. (1998). Friendship and group identification: A new look at the role of cohesiveness in groupthink. *European Journal of Social Psychology, 28*(3), 323–341.

Jackson, J.W. (2002). Intergroup attitudes as a function of different dimensions of group identification and perceived intergroup conflict. *Self and Identity, 1*, 11-33.

Jacob, C. S., & Carron, A. V. (1998). The association between status and cohesion in sports teams. *Journal of Sports Sciences, 16*, 187-198.

Jostad, J., Paisley, K., Sibthorp, J., & Gookin, J. (2013). The multi-dimensionality of group cohesion: A temporal examination of NOLS courses. *Journal of Outdoor Recreation, Education, and Leadership*, *5*, 131-135.

Jostad, J., Sibthorp, J., & Paisley, K. (2013). Understanding groups in outdoor adventure education through social network analysis. *Australian Journal of Outdoor Education, 17*(1), 17-31.

Judge, T.A., Piccolo, R.F., & Ilies, R. (2004). The forgotten ones? The validity of consideration and initiating structure in leadership research. *Journal of Applied Psychology, 89*(1), 36-51.

Martin, B., Cashel, C., Wagstaff, M., & Breunig, M. (2006). *Outdoor leadership theory and practice*. Champaign, IL: Human Kinetics.

McKenzie, M.D. (2000). How are adventure education program outcomes achieved?: A review of the literature. *Australian Journal of Outdoor Education, 5*(1), 19-28.

McKenzie, M.D. (2003). Beyond the "Outward Bound process:" Rethinking student learning. *Journal of Experiential Education, 26*(1), 8-23.

McMillan, D.W., & Chavis, D.M. (1986). Sense of community: A definition and theory. *Journal of Community Psychology, 14*, 6-23.

Norton, C.L., & Watt, T.T. (2014). Exploring the impact of a wilderness-based positive youth development program for urban youth. *Journal of Experiential Education, 37*(4), 335-350.

Oakes, P.J., Haslam, S.A., & Turner, J.C. (1994). *Stereotyping and social reality*. Oxford, England: Blackwell.

Paisley, K., Jostad, J., Sibthorp, J., Pohja, M., Gookin, J., & Rajagopal-Durbin, A. (2014). Considering students' experience in diverse groups: Case studies from NOLS. *Journal of Leisure Research, 46*(3), 329-341.

Pugh, M.J., & Hart, D. (1999). Identity development and peer group participation. *New Directions for Child and Adolescent Development, 84*, 55-70.

Raudenbush, S.W., & Bryk, A.S. (2002). *Hierarchical linear models: Applications and data analysis methods, second edition.* New York, NY: Sage Publications.

Rose, J., & Paisley, K. (2012). White privilege in experiential education: A critical reflection. *Leisure Sciences, 34*, 136-154.

Scholte, R., & Van Aken, A.G. (2006). Peer relations in adolescence. In S. Jackson & L. Goossens (Eds.), *Handbook of adolescent development* (pp. 175-199). New York, NY: Psychology Press.

Schumann, S., Paisley, K., Sibthorp, J., & Gookin, J. (2009). Instructor influences on student learning at NOLS. *Journal of Outdoor Recreation, Education, and Leadership, 1*(1), 15-37.

Seijts, G.H., & Latham, G.P. (2006). The effects of goal setting and group size on performance in a social dilemma. *Canadien Journal of Behavioral Science, 32*, 104-116.

Slocum, J.W., Cron, W.L., & Brown, S.P. (2002). The effect of goal conflict on performance. *The Journal of Leadership and Organizational Studies, 9*(1), 77-90.

Sibthorp, J., Furman, N., Paisley, K., Gookin, J., & Schumann, S. (2011). Mechanisms of learning transfer in adventure education: Qualitative results from the NOLS transfer survey. *Journal of Experiential Education*, *34*, 109-126.

Sibthorp, J., & Jostad, J. (2014). The social system in outdoor adventure education programs. *Journal of Experiential Education, 37*(1), 60-74.

Sibthorp, J., Paisley, K. & Gookin, J. (2007). Exploring participant development through adventure-based programming: A model from the National Outdoor Leadership School. *Leisure Sciences, 29*, 1-18.

Stogdill, R.M. (1963). *Manual for the Leader Behavior Description Questionnaire, Form XII.* Columbus, OH: Bureau of Business Research, Ohio State University.

Tajfel, H. (1981). *Human groups and social categories: Studies in social psychology.* Cambridge, England: Cambridge University Press.

Tubbs, S.L. (2012). *A systems approach to small group interaction* (11th ed.). New York, NY: McGraw Hill.

Tuckman, B., & Jensen, M. (1977). Stages of small group development revisited. *Group & Organization Studies, 2*(4), 419-427.

Van Ryzin, M.J., Gravely, A.A., & Roseth, C.J. (2009). Autonomy, belongingness, and engagement in school as contributors to adolescent psychological well-being. *Journal of Youth and Adolescence, 38*(1), 1-12.

Walsh, V., & Golins, G. L. (1976). *The exploration of the Outward Bound process*. Denver, CO: Colorado Outward Bound School.

Warren, K., Roberts, N.S., Breunig, M., & Alvarez, M.A. (2014). Social justice in outdoor experiential education: A state of knowledge review. *Journal of Experiential Education, 37*(1), 89-103.

Windle, M. (1994). A study of friendship characteristics and problem behaviors among middle adolescents. *Child Development, 65*, 1764-1777.

Yukl, G. (2006). *Leadership in organizations* (6th ed.). Upper Saddle River, NJ: Pearson.

Table 2.1. Test Statistics for the Affective Dimension

		β	*SE*
Level 1	GCO*	-0.106	0.030
	GCI	-0.056	0.045
	SSN**	0.031	0.013
	SEX	-0.072	0.077
Level 2	LC**	0.335	0.161
	SEXR**	0.641	0.200
	SCHR	-0.095	0.123

* $p < .001$; **$p < .05$

Table 2.2. Test Statistics for the Cognitive Dimension

		β	*SE*
Level 1	GCO*	-0.300	0.046
	GCI	-0.024	0.050
	SSN**	0.035	0.018
	SEX	-0.076	0.091
Level 2	LC	-0.112	0.281
	SEXR	0.070	0.222
	SCHR	0.253	0.205

*$p < .001$; **$p \leq .0$

CHAPTER 3

USING DYNAMICAL SYSTEMS THEORY IN OUTDOOR ADVENTURE EDUCATION RESEARCH

Abstract

A challenge of studying outdoor adventure education is the multifaceted nature of these programs. Many components can influence the development of student outcomes, but researchers have little control in reducing these influences because of the naturalistic setting of such programs. To take on these challenges, this chapter advocates for the use of a dynamical systems theory (DST) approach. The foundations, assumptions, and descriptors used to explain DST phenomena are introduced. Methodological considerations and an example analysis are presented.

Introduction

When Tim arrived for his outdoor adventure education course he was very nervous and anxious. This was the first time he had been away from home for weeks at a time and the first time he had gone backpacking. Tim had always struggled to find friends at home and now he was in a group with 11 students he had never met prior to this course. Feelings of isolation crept up inside of him but he was motivated to learn as much as possible, not only about the wilderness but about himself.

The first couple days of Tim's course were a challenge, as he was required to

learn the basic technical skills of the course, in addition to trying to get to know everyone. After the first three days of the course he struggled to develop social connections with his tent group because they did not share his same interests and were not from the area where he lived. He felt as though he connected best with another student on the course, Jake, but they had not hung out with each other very much because there was so much to learn and so many tasks to complete. One of the instructors had developed good rapport with Tim by checking in every day and showing concern for Tim's well-being. The relationship with his instructor was very helpful at the beginning of the course and helped him persevere through the social challenges of the course. By day seven of the course the group changed tent groups and Tim was now in a group with Jake. Tim was able to develop an extremely close relationship with Jake and the others in his tent group after spending more time with them. Tim's experience changed dramatically when he was finally able to "connect" to other students on his course.

The scenario above is common in outdoor adventure education (OAE); however, there are many factors that may play a role in how a student connects with others on a course. The complex relationships between the student, the others in the group, and the environment in which these experiences take place, create a challenge to studying OAE phenomena. To explain student behavior through the traditional social-psychological paradigm, that is, testing and modeling behavior as a linear "cause and effect" relationship between two variables, provides a very limited scope of understanding. Behavior is rarely, if ever, a linear and independent relationship between two variables; rather, the complexity of behavior is a result of the interdependency between the self, environment, and others (Lerner, 2002). Understanding the how and why of OAE

remains challenging because of the multifaceted nature of the programs, participants, instructors, and the physical environment (Ewert & Sibthorp, 2014).

Outdoor adventure education programs are comprised of multiple components that interact over multiple time scales to contribute to the learning and experience of a student (McKenzie, 2000; Sibthorp & Jostad, 2014; Walsh & Golins, 1976). For example, OAE programs offer different and sometimes multiple activities, stress different outcomes, and implement their programs with different approaches. These simple nuances, while seemingly minor, can have vast influences on the outcomes of a student. Students who participate in OAE courses also come from a variety of backgrounds with different goals for the course. Some may have the resources to participate in past backcountry experiences, whereas others may have never spent a night in a tent. Instructors play a central role and influence a multitude of aspects within an OAE course (Brown, 2002; Shooter, Paisley, & Sibthorp, 2008). The remoteness and challenge the physical environment can have on participants also contribute to the variety of influences on every OAE course. One way to better explain the complex nature of OAE may be through the use of dynamical systems theory (DST).

Dynamical systems theory recognizes that phenomena are comprised of multiple interconnected parts that continually interact with one another to produce emergent phenomena (Kelso, 1995). The goal of DST is not to measure every part of the system and determine the type of influence it may produce, but rather to examine the patterned behavior of a system over time (Wiese, Vallacher, & Strawinska, 2010). While the field of psychology has seen a growth of DST studies in areas such as motor development (Thelen & Smith, 2006), familial interaction (Magnavita, 2012), dyad communication

and interactions (Fogel, 2006; Gottman, Swanson, & Swanson, 2002), sex-based interactions (DiDonato et al., 2012), personality (Shoda, LeeTiernan, & Mischel, 2002), and identity (Lichtwarck-Aschoff, van Geert, Bosma, & Kunnen, 2008), there have not been any studies within the context of OAE that have measured or modeled behavior with such a framework. Due to the multifaceted nature and complexity of influential factors within OAE programs, this theoretical framework deserves attention. Therefore, the purpose of this chapter is to explain the theoretical foundations of DST and provide a modeling technique that can be employed by researchers.

Dynamical Systems Theory

Dynamical systems theory is a concept that has deep roots in social psychology and has long been used to describe phenomena; however, recent advances in mathematics and statistical programs have provided the ability to measure the changes in systems more accurately. The term 'dynamical systems', in its most elementary form, refers to the measurement of change within a system over time. Dynamical systems models are composed of mathematical equations that describe time-based systems and the changes that occur within these systems (Granic, Hollenstein, Dishion, & Patterson, 2003). Furthermore, dynamical systems posit that contextual factors, the parts that comprise the system, also influence the change in the system. Observing this change and understanding the components that influence the temporal patterning within a system are of central importance. As Thelen and Smith (2006) suggest, "the value of dynamic systems is that it provides theoretical principles for conceptualizing, operationalizing, and formalizing these complex interrelations of time, substance, and process" (p. 258).

This type of thinking is different than traditional approaches in three fundamental ways (McGrath, 1997). First, the focus of research is on the entire system and not directed on single variable effects, which provides a macro perspective on the phenomena of interest. Second, the state of the system is reflected in the emergence of system-level phenomena that are influenced through micro-level interactions. Third, the goal of DST is to understand the trajectory of the system, or in other words, the spatio-temporal dance of the system. Therefore, DST seeks to measure and model this change in systems through a language of space and time.

A DST perspective recognizes that there are multiple aspects that influence how Tim connects with other students on the course and that this changes over time. Rather than trying to focus on one or two variables that influence how Tim connects to other students, such as his personality or goals for the course, DST asserts that the focus should be to understand the unfolding of the macroscopic behavior. Therefore, the development of how Tim socially connects to others in his group is of interest. The following will discuss some of the foundational assumptions of DST.

Foundational Assumptions

To begin an understanding of DST, some of the foundational assumptions must be described. These assumptions guide how phenomena are conceptualized and the types of tools that might be used to analyze dynamical systems.

Emergence and Self-Organization

Two of the main assumptions of dynamical systems are emergence and self-organization. Emergence suggests that the interaction of the lower-order parts of a system

produce a pattern of behavior that is new or different than that which existed prior (Wiese et al., 2010). That is, the individual parts of the system interact in such a way as to produce something qualitatively different than the parts alone. This new emergent behavior of the system is a spontaneous product of self-organization.

Self-organization is the way in which the parts of the system interact with one another to produce emergent global behavior (DiDonato, England, Martin, & Amazeen, 2013). Self-organization does not have a causal agent requiring the parts to interact in a particular way, rather, the process is spontaneous (DiDonato et al., 2013). A common example of self-organization and emergence is the Raleigh-Benard instability. When oil is poured into a pan the molecules are moving about randomly; however, when a source of heat is added to the oil and the temperature is increased, the molecules create convection cells within the liquid. That is, a new pattern emerges in the oil due to a change in the temperature gradient. There is not one molecule telling the other molecules what to do, rather, the interaction of the molecules together produce a new emergent pattern. Thus, to understand this system, it is not necessary to observe every single molecule because the interest is not in the molecules themselves, but rather the emergent behavior that is produced.

Considering Tim's experience, there are many different aspects that influence how he socially connects with others on his course. However, these connections cannot be explained solely by his sex or age (the parts of the system), rather it is through the interaction of multiple parts (age, sex, personality, interests) that leads to the emergence of this feeling of connection with others. Rather than measuring all of these parts, the focus should be on the behavior of the system (development of connection) over time.

Thus far a bottom-up approach of development has been suggested; however, DST also recognizes that the components of the system are constrained, or enslaved, by the macroscopic behavior of the system. That is, system behavior is developed through the interaction of the parts of the system, but these interactions are also determined by the emergent behavior (Lichtwarck-Aschoff et al., 2008). This notion is what Kelso (1995) calls the principle of circular causality: "What we have here is one of the main conceptual differences between the circularly causal underpinnings of pattern formation in nonequilibrium systems and the linear causality that underlies most of modern physiology and psychology" (p. 9). For example, Tim's behavior may influence how other students behave or interact with him, whereby the interactions of the other students can also influence Tim's behavior.

Sensitivity to Initial Conditions

An important concept to dynamical systems is the notion that non-linear dynamical systems are sensitive to initial conditions. Remember that DST is a developmental theory, meaning that the goal is identifying the emergent patterns of a system over time. Small initial differences in initial conditions or measurements can lead to vast differences in long-term predictions (Mitchell, 2008; Spencer & Perone, 2008). Not only does this assumption reiterate the importance of accurate measurements, but it provides a foundation of how data can be analyzed. If initial states of the system can provide information about future trajectories of the system, then it is possible to use these current states as predictors for the future. For example, the level of connection Tim feels at home with his peers can be seen as the initial conditions. If he struggles to connect with his peers at home he may feel this at the beginning of the course. His lack of

connection at the beginning of the course may ultimately hinder his ability to develop a strong— or stable— connection with others by the end of the course.

Stability

Another key assumption is that systems generate stable patterns. System theorists assume that all systems are open systems, "energy" is constantly coming into and out of the system at a given time. This notion recognizes that systems are constantly changing and may vary from one moment to the next, but particular types of stability occur in order for the system to be most efficient. However, there is constantly energy that disturbs this stability, which is known as a perturbation. Perturbations are the micro changes within a system from all of the interconnected parts (Butner, Gagnon, Guess, Lessard, & Story, 2015). These perturbations can tell us about the stability of a system but are not modeled within the system. Stability provides the basis from which systems can be described. Order parameters, control parameters, attractors, and repellers are terms used to describe these stable states.

There is a level of connection with the group that Tim feels most comfortable with and he naturally gravitates toward this level of connection throughout the course. However, there are many aspects within the course that may move him around this particular state, such as the number of students in the group or the challenges of the day. These aspects of the course represent perturbations that move Tim around his stable state.

These assumptions provide the foundation of how DST phenomena are conceptualized, and, thus, guides how systems are described and modeled. The following is a description of common terms used to depict dynamical systems.

Describing Dynamical Systems

Order Parameter

One of the crucial elements in defining the system is identifying the system-level variable of interest known as an order parameter. Order parameters represent the emergent behavior of the system that is of interest (Thelen & Smith, 2006). To some extent, order parameters are similar to dependent variables in social-psychological research; however, order parameters differ from dependent variables in two main respects. First, while dependent variables are described or explained by predictor variables (e.g., independent variables), order parameters provide an understanding of the system in relation to their change over time (Vallacher & Nowak, 1997). That is, order-parameter values are determined by the previous measured moments in time. As discussed earlier, given that we know the initial values or states of a system, predicting future values is possible. A second difference between order parameters and dependent variables is that they must uniquely describe overall systematic conditions that evolve and change over time (Vallacher & Nowak, 1997). Therefore, order parameters must have the ability to change over time and not be static. These two conditions are important to note when choosing an order parameter. There are a number of phenomena that can be considered order parameters in OAE, such as the development of self-efficacy, prosocial behaviors, and learning. In the above example, the way Tim connects to other students may be considered an order parameter because how he connects with others is a phenomena that is influenced by its previous states and changes over time.

Control Parameter

As order parameters can be likened to dependent variables in classical methodology terms, control parameters can be likened to independent variables. That is, control parameters are those that influence or change the trajectory of the order parameter (Thelen & Smith, 2006). While many parameters within a system may have some quantitative influence on the order parameter, typically only a few will be able to develop noteworthy qualitative change. For example, the level of connection Tim feels with other students may be influenced by how his goals for the course differ from others in his group. These differing/conflicting goals may be so prominent that they create a qualitative change in his trajectory of connection with others. It may be possible for him to feel connected to others in the group, but after realizing that his motives (to develop leadership skills) differ from those of his peers (to hang out), he could feel isolated and not well connected. As Vallacher and Nowak (1997) note, "describing the effect of such a variable is clearly more enlightening about the system than is describing the effect of variables that produce only quantitative effects" (p. 79). The way that DST describes the influence that control parameters have on order parameters is through attractors and repellers.

Attractors and Repellers

Attractors and repellers are a critical element in understanding dynamical systems because they provide a measure of stability for the system. Attractors and repellers represent different states within the phase space. The phase space is specified by measured coordinates that represent the location and trajectory of the order parameter through time (Abraham & Shaw, 1992; Nowak & Lewenstein, 1994). This space can be

represented through multiple dimensions, but the most common are one-dimensional, two-dimensional, and three-dimensional space. The movement or trajectory of the order parameter within this phase space represents the stability of the dynamical system.

Attractors are a given location or area within the phase space where the trajectory of the order parameter slows and converges into a more stable state (Thelen & Smith, 2006). There are multiple types of attractors such as fixed-point attractors, limit-cycle attractors, multiperiodic attractors, and quasiperiodic attractors (Nowak & Lewenstien, 1994). For the purposes of this review, only fixed-point and limit-cycle attractors will be discussed.

Fixed-point attractors occur when all trajectories of the system converge on one point, regardless of the initial starting point (Thelen & Smith, 2006). One of the easiest ways to illustrate this concept is by considering different basins (attractors) that a ball (order parameter) may fall into or come to rest, given the different dimensions of the system (see Figure 3.1). The deeper the well, the stronger the fixed point attractor and, thus, the more energy it will take to move the ball into another attractor state. This is a fixed-point attractor because once the ball falls into a particular basin, it will always gravitate toward the bottom of the basin. A stronger attractor will show more stability (the first basin in Figure 3.1) whereas a weaker attractor will show less stability (the second basin in Figure 3.1). These stable states are where the order parameter gravitates given the expected combinations of control parameters on the system.

It is possible that Tim may connect with Jake better than any other person in his group. When Tim is feeling lonely or missing his family, Jake provides the understanding he needs to feel connected to the group. Tim also prefers to be around

Jake when he is feeling good about the group. This is an example of fixed-point attractors, because Tim always gravitates toward Jake no matter how he might be feeling.

Limit-cycle attractors, or periodic attractors, represent a trajectory of the system that moves cyclically between two or more states (DiDonato et al., 2013). These types of attractors visit multiple points in the phase space repeatedly. Fixed-point attractors and limit-cycle attractors can also be represented by Figure 3.2. This representation of fixed point attractors shows all behavior gravitating toward a single point within the phase space, whereas the periodic attractor cycles between two or more given points.

To consider limit-cycle attractors, it is best to think about something that oscillates between two or more states. In Tim's group, getting out of camp is difficult because of the cold early mornings and knowledge that the day will be physically challenging. These aspects of the course may make the students irritable and create conflict between students. Every morning Tim feels disconnected with students because of these aspects of the course, which can represent one point in a limit-cycle attractor. After Tim's group arrives to camp every day the accomplishments that everyone achieved are recognized through the telling of stories and the challenges they overcame. During this time in the day Tim feels well connected to others because everyone is sharing personal stories and the mood is fun and exciting. The feeling Tim has at this point in the day could represent another state in this limit cycle. Therefore, Tim may cycle between feeling disconnected in the mornings and connected in the evenings throughout his entire course.

Repellers are areas within the phase space from where the order parameter tends to move away. Repellers are often found between two attractors. If we consider Figure

3.1, the area between the two attractors can be viewed as a repeller because the ball will always move away from the top of the well. Repellers represent unstable areas of the state space where order parameters do not gravitate. Kelso (1995) suggests that instabilities provide three aspects of understanding to the system. First, they demarcate behavioral patterns by providing an awareness of stability changes between the attractor basins. Second, instabilities provide a way to model the order parameter behavior and see how the control parameters move the system through the phase space. Third, instabilities provide a way to anticipate future pattern changes and the length of time it takes for a system to recover from a perturbation. Recognizing these areas of instability within a given phase space is important in understanding the qualitative changes of the order parameter.

Phase Transitions

Phase transitions refer to the qualitative shift or change that occurs in the order parameter due to changes in the control parameter (DiDonato, et al., 2013). This change brings about something qualitatively different than before and serves as a transition from one attractor state to the next. Considering Figure 3.1 again, there are two attractor basins in the phase space separated by a repeller. One attractor is stronger than the other but the state of the system can be pushed from one attractor to another attractor. For example, stronger connections with others on OAE courses can result from shared challenging experiences. Low levels of challenge on a course may represent one attractor basin and a level of connection between students that is represented by superficial teamwork. Increasing the level of challenge and providing more opportunities for challenge can create a transition into a new attractor state of connection. This new

attractor state may be represented by students communicating, supporting one another, and problem solving. The ideas described above are the foundations to understanding how dynamical systems are conceptualized and described. The next section will describe and demonstrate one approach of how dynamical systems can be measured and modeled.

Modeling Dynamical Systems

A variety of tools can be used to measure and model dynamical systems (topology, state space grids, nondifferential equations, STELLA), and each serves to answer/inform different research questions. For example, topology is a graphical representation of differential equations via maps (see Butner et al. 2015). State space grids are another graphical approach that uses ordinal data and displays the data on two dimensions (see Hollenstein, 2007). Another approach is through the use of simulations with software such as STELLA (see Wells, Ruddell, & Paisley, 2006). Many of the tools can be quite complex, but a simple set of tools can be used for many common research questions. The following will provide an example of how to use regression techniques to model a dynamical system in OAE research.

Data Collection

One of the difficult aspects of collecting DST data in OAE is the requirement of repeated measures over time. For the data to be meaningful, it requires at least three time points and needs to show change in the order parameter. Collecting data more frequently is preferred, as this provides a better description of the system over time. However, it is important to consider the time and rate at which the phenomena of study develop. For example, if trying to understand the development of social connections, measurements

should be administered early and frequently in the course.

Data for this example of modeling were collected from two spring semester courses from the National Outdoor Leadership School (NOLS) for the first 9 days of courses in 2015. Both courses began with a 3-day wilderness medicine section before beginning a backpacking section in the Rocky Mountains. A total of 24 students completed questionnaires the first 9 days of the course and consisted of 17 males and 7 females with a mean age of 20.2 years.

Order Parameters and Control Parameters

Sibthorp and Jostad (2014) developed a model of the social system using a systems theoretical framework. Their model recognized many of the main components in the social system and how they might interact with one another. Using this model as a framework, sense of belonging was the order parameter that was measured using the Feeling of Social Belonging Scale (Richer & Vallerand, 1998).

Two variables were measured to be used as the control parameters in this study. Goal conflict was used to represent the goal component of the Sibthorp and Jostad (2014) model. Goal conflict describes the extent to which students felt they wanted similar outcomes as others on the course. Instructor support was used to represent the instructor component of the model and is defined as the level of care and support an instructor provides the students.

Analysis: Change as Outcome Model

Because dynamical systems are fundamentally interested in change, change becomes the outcome variable in the data (Butner et al., 2015). One way to create a change value is to make a lead variable and then compute a difference score for each

individual. A difference score can be computed by subtracting the value of the present state of the system from the next time point (the lead). This simple difference score represents a first-order derivative of velocity, which suggests how fast the order parameter is changing. Because DST assumes that the given value of an order parameter at time 1 will provide information on the future trajectories of the system, the current value of a student's sense of belonging can be used to predict its own change. This is the baseline model in a DST analysis because it depicts the underlying pattern of the order parameter. These notions, while somewhat different than traditional methods, align with how systems are conceptualized. That is, time has been built into the data, rather than using time as a predictor variable as in traditional growth models. A graphical representation is provided in Figure 3.3 by viewing the change of sense of belonging as the outcome variable and the present value as the predictor variable. From this simple graph, the notions of stability and attractors can also be extrapolated.

The value of sense of belonging is shown on the x-axis and the change in sense of belonging on the y-axis. The dashed line in the graph represents an area of no change, and this has a special name called the *set point*. The set point is the place from which behavior is depicted because it represents stability (Butner et al., 2015). If, for example, the negative sloping line represented the data of a single time individual, then this graph would represent an attractor. By looking at the value of sense of belonging (on the x-axis) that is higher than the set point, this student would have negative change (y-axis). That is, when a student's level of sense of belonging is higher than the set point, it tends to decrease or "attract" toward its set point. When the value of sense of belonging resides below the set point, change will be positive and the student will be drawn toward the set

point. Fundamentally, negative sloping lines represent attractors. On the contrary, positive sloping lines represent repellers, because when the value of sense of belonging is above the set point, change is positive, and thus, moves them farther away from the set point (see Figure 3.4). This graph provides information about what value of sense of belonging people are attracted toward and shows the strength of this attraction. A steeper slope shows a stronger attractor or repeller, whereas a slope that is less steep shows a weaker attraction or repulsion.

When the data are conceptualized in these terms, it is possible to identify points or areas of attraction and the rate at which students move toward these states; however, these notions can be measured with relatively simple equations. When looking at a single time series of data for one person, it is possible to measure set points, attractors, and repellers using the following regression equation:

$$X_{t+1} - X_t = b_0 + b_1 (X_t) + e$$

The $X_{t+1} - X_t$ represents the change that is occurring in sense of belonging from the student's present value to their future value. The b_0 represents the y intercept and the b_1 (X_t) represents the slope of the equation given a value of X. The set point and strength of attraction or repulsion of the system can be calculated through the above equation. By setting change to zero (because the set point represents no change), the set point can be measured within the system by the equation:

$$0 = -b_0 / b_1$$

The regression model will provide a slope (b_1, the attraction or repulsion) and intercept value ($-b_0$), which can then be plugged into the above equation to determine the value of the set point. Whether the slope is an attractor or repeller can be determined by the sign of the slope (positive or negative) and the strength of the slope is indicated by the value of the coefficient.

To illustrate how this works using a single time series from these data, imagine Figure 3.5 shows a graph of Tim with his current level of sense of belonging (on the x-axis) predicting his change (on the y-axis). The graph suggests attractive behavior due to the negative sloping line. The set point can be computed using the equation above with the slope of -0.88 and a constant value of -0.22 (all predictor variables have been grand mean centered). This particular model shows an attractor (-0.88) with a set point value of -0.25, which is approximately what is shown on the graph. Also interesting is the fact that this equation alone accounts for 62% of the variance in Tim's change in sense of belonging. So far an explanation of how an order parameter predicts its own change has been presented, but of interest is how control parameters control the system.

Another piece which can be added to this equation is a control parameter that may alter the trajectory of the system. For example, a difference in goals (goal conflict) between students on the course may alter their sense of belonging in two ways. Control parameters can alter both the location of the set point and the strength of attraction or repulsion. If a control parameter is added as a main effect, it has the ability to only change the set point of the equation, but not the slope (Butner et al., 2015). However, if an interaction term is added to the equation, the potential of changing the set point and the strength of attraction or repulsion is possible (Butner et al., 2015). That is, by adding

an interaction between the value of sense of belonging and goal conflict, it is possible not only to change the set point, but also the strength (slope) of an attractor or repeller. Multilevel modeling can be used to expand this notion beyond one time series.

Change as Outcome Models with Multilevel Modeling

The change of one person is rarely of interest to social scientists; rather, measuring multiple people is often the goal. Multilevel models provide the ability to model variables that are not independent and can handle missing data (Raudenbush & Bryk, 2002). The same steps as above can be used to create a lead variable in order to calculate the change variable; however, one important step is to ensure this change variable is created for each person and not over all people. If done correctly, each person should have one missing data point in the final cell of his/her data. The following analyses have been conducted by using a 2-level multilevel model using Hierarchical Linear Modeling (HLM) software. All data presented here have been grand-mean centered, which provides a deviation from the average of all students as opposed to a deviation from their own average. This type of centering provides a better metric to understand the differences between individuals.

Figure 3.6 shows a linear plot for all students over the nine days with change in sense of belonging as the outcome and the current value of sense of belonging as the predictor. This graph suggests a fixed-point attractor exists at approximately a value of 0.5 and shows that 15% of the variance can be explained by this equation. Using the values of the intercept and the slope, it is possible to mathematically calculate the set point. The slope in this model has a value of -0.38 and an intercept of 0.11. According to the equation mentioned above, the set point can be determined by dividing the

intercept by the slope (–(0.11)/-0.38), which equals 0.29. The strength of this set point can be determined by looking at the value of the slope, which in this equation is -0.38. These values are somewhat different than what Tim's data showed. Tim had a much lower set point and showed stronger attractive behavior than the average student, which could have been a result of his difficulties at the beginning of the course.

Due to the nature of this population and the construct, it is feasible that students may vary in their set points and in their slopes. That is, students may have different set points and may move toward those set points at different rates. To understand if this exists, variance components on the intercept and slopes were modeled. According to these data, there were both significant variance components on the intercepts and the slopes ($p < .01$).

In order to understand why people may differ on the variance components, control parameters were added to the model. First, the level 1 control parameter of goal conflict was added both as a main effect and an interaction. According to this model, there was not a significant main effect but there was a significant interaction ($\beta = -0.05$, $p = .05$), which suggests that for every 1-unit increase in daily goal conflict, the slope of a student's change becomes more attractive by 0.05 units. That is, students who have more goal conflict with others tend to gravitate toward the attractor faster. This change in the slope also makes it more stable, and thus more difficult to change from. The set point in this model did not significantly change.

Instructor support, a level-2 predictor, was also modeled as a main effect and an interaction. This model showed a significant main effect ($\beta = 0.20$, $p = .01$) but did not show a significant interaction. This result suggests that for every 1-unit increase in

instructor support, the student increased their level of sense of belonging by 0.20 units. That is, students who felt more support from their instructors had higher levels of belonging.

To put these results in context, these data suggest that on days when the average student in Tim's group had higher levels of goal conflict, the faster the student moved toward his/her set point in belonging. This increase in the slope indicates that the average student's set point is more stable, which makes it more resistant to perturbations, but also more difficult to change. If, for example, they wanted to increase their sense of belonging, goal conflict makes it more difficult for them to make this change. Theoretically we would expect a decrease in the set point, meaning that a student's value of sense of belonging would decrease when goal conflict is added as a control parameter. These data do not show a decrease in the set point, but only show a change in the slope. Instructor support showed a positive change in the set point for the average student. When they feel more care and support from their instructors, the set point increases, meaning they gravitate toward a higher level of sense of belonging.

There are a variety of ways to calculate effect sizes in multilevel modeling and there is not a consensus as to what method is superior (Peugh, 2008). While many studies may use the variance components as a marker for effect size, this chapter follows the recommendation by Snijders and Bosker (1999) due to the outcome variable of change. To calculate the effect size of this model, the predicted and residual values were saved from the model and then aggregated by the standard deviation. The predicted standard deviation (PREDSD) and residual standard deviation (RESSD) were used to calculate the effect size using the following equation:

ES = PREDSD*PREDSD/ ((PREDSD*PREDSD) + (RESSD*RESSD))

Using this equation, this DST model accounted for 43% of the variance in the change of sense of belonging. The following section provides a further description to understand and conceptualize DST results.

Understanding DST Results

Remember that the focus of DST is not to advocate for cause and effect relationships, but to track the temporal patterns of phenomena and understand what components within the system can alter this pattern. Fundamentally this type of analysis suggests that depending on the current value of a student's level of belonging, it is possible to determine how he/she will change in the future and the rate at which this may occur. The first part of this analysis, predicting change by the current value of sense of belonging, acts as a baseline model. From this, it is possible to determine the stable (attractors) areas within the system and how a student moves (changes) toward those stable points. Because these data were grand-mean centered, the attractor existed above the zero point, meaning a student's level of sense of belonging tended to stabilize 0.29 units above the average of all students. Therefore, when students had lower values of sense of belonging, they gradually moved toward the set point over time. The slope of this equation serves to show how fast students move toward this stable state and acts as a marker for the strength of the attractor.

The control parameters were used to explain if these components of the system influence the temporal pattern of the order parameter. These data showed significant variance components on the intercept and the slope and the control parameters were used to explain aspects of this variance. The significant interaction of goal conflict and sense

of belonging showed that this control parameter increases the rate at which students move toward the attractor state on a daily basis. That is, the current level of sense of belonging moderates the relationship between daily goal conflict and change in sense of belonging. In addition, this interaction suggests that the attractor is more stable when goal conflict exists, meaning it is more difficult for students to change their level of belonging once it gravitates toward the attractor.

The second control parameter was the level-2 predictor of instructor support. This result only showed a significant main effect, meaning the value of the set point showed a positive increase when students felt they had greater support from their instructors over the entire 9 days. The slope of the equation was not altered, suggesting that the rate of change toward the set point did not significantly change.

Applying these findings to Tim's experience can help understand how goal conflict acts as a control parameter. The change in slope suggests that goal conflict makes him move toward the attractor faster and makes it more difficult for Tim to change his level of belonging once he has reached the attractor state. The instructor support control parameter also suggests Tim increases his sense of belonging when feeling supported by his instructors. The slope does not change which means he does not gravitate toward this set point at a different rate because of instructor support.

Conclusion

The purpose of this chapter was to show how DST can be used as a theoretical and methodological tool in OAE research. While a variety of tools and resources can be used to analyze dynamical systems, this paper illustrated one approach that uses familiar statistical analyses and equations. Ultimately, using a DST framework requires an

adjustment of how phenomena are viewed and understood. Rather than seeking cause and effect relationships, the first step may need to be a step back, by focusing on observing a system over time. In order to understand the processes of OAE programs, a theory is needed that helps to understand the process of change, and DST provides one way to accomplish this task.

Tim's experience on an OAE course is incredibly important to understand, however, his experience occurs in a dynamic and complex setting consisting of multiple interacting parts. In order to truly advance the understanding of what occurs during OAE programs, researchers need to recognize and acknowledge multiple variables that influence outcomes in OAE (Scrutton & Beames, 2015). Dynamical systems theory provides a platform to take on these challenges, which can help understand the development of many outcomes Tim may gain from his OAE experience.

References

Abraham, R., & Shaw, C.D. (1992). *Dynamics: The geometry of behavior* (2nd ed.). Redwood City, CA: Addison-Wesley.

Brown, M. (2002). The facilitator as gatekeeper: A critical analysis of social order in facilitation sessions. *Journal of Adventure Education and Outdoor Learning, 2*(2), 101-112.

Butner, J.E., Gagnon, K.T., Guess, D.A., Lessard, D.A., & Story, N. (2015). Utilizing topology to generate and test theories of change. *Psychological Methods, 20*(1), 1-25.

DiDonato, M.D., Martin, C.L. Hessler, E.E., Amazeen, P.G., Hanish, L.D., & Fabes, R.A. (2012). Dynamical patterns of children's gendered behavior. *Nonlinear Dynamics, Psychology, and Life Sciences, 16*, 59-184.

DiDonato, M.D., England, D., Martin, C.L., & Amazeen, P.G. (2013). Dynamical analyses for developmental science: A primer for intrigued scientists. *Human Development, 56*, 59-75.

Ewert, A., & Sibthorp, J. (2014). *Outdoor adventure education: Foundations, theory, and research.* Champaign, IL: Human Kinetics.

Fogel, A. (2006). Dynamic systems research on interindividual communication: The transformation of meaning-making. *Journal of Developmental Processes*, *1*, 7-30.

Gottman, J., Swanson, C., & Swanson, K. (2002). A general systems theory of marriage: Nonlinear difference equation modeling of marital interaction. *Personality and Social Psychology Review, 6*(4), 326-340.

Granic, I., Hollenstein, T., Dishion, T.J., & Patterson, G.R. (2003). Longitudinal analysis of flexibility and reorganization in early adolescence: A dynamic systems study of family interactions. *Developmental Psychology, 39*(3), 606-617.

Hollenstein, T. (2007). State space grids: Analyzing dynamics across development. *International Journal of Behavioral Development, 31*(4), 384-396.

Kelso, S. (1995). *Dynamic patterns: The self-organization of brain and behavior*. Cambridge, MA: MIT Press.

Lerner, R.H. (2002). *Adolescence: Development, diversity, context, and application*. Upper Saddle River, NJ: Prentice Hall.

Lichtwarck-Aschoff, A., van Geert, P., Bosma, H., & Kunnen, S. (2008). Time and identity: A framework for research and theory formation. *Developmental Review, 28*, 370-400.

Magnavita, J. J. (2012). Advancing clinical science using system theory as the framework for expanding family psychology with unified psychotherapy. *Couple and Family Psychology: Research and Practice*, *1*(1), 3-13.

McGrath, J.E. (1997). Small group research, the once and future field: An interpretation of the past with an eye toward the future. *Group Dynamics: Theory, Research, and Practice, 1*(1), 7-27.

McKenzie, M.D. (2000). How are adventure education program outcomes achieved?: A review of the literature. *Australian Journal of Outdoor Education, 5*(1), 19-28.

Mitchell, M. (2008). *Complexity: A guided tour.* New York, NY: Oxford University Press.

Nowak, A., & Lewenstein, M. (1994). Dynamical systems: A tool for social psychology? In R.R. Vallacher & A. Nowak (Eds.), *Dynamical systems in social psychology* (pp. 17-53). San Diego, CA: Academic Press.

Peugh, J.L. (2008). A practical guide to multilevel modeling. *Journal of School Psychology, 48*, 85-112.

Raudenbush, S.W., & Bryk, A.S. (2002). *Hierarchical linear models: Applications and data analysis methods* (2nd ed.)*.* Thousand Oaks, CA: Sage.

Richer, S.F., & Vallerand, R.J. (1998). Construction et validation de l'Echelle du sentiment d'appartenance sociale (ESAS). *Revue Européenne de Psychologie Appliquée, 48*(2), 129-137.

Shoda, Y., LeeTiernan, S., & Mischel, W. (2002). Personality as a dynamical system: Emergence of stability and distinctiveness from intra- and interpersonal interactions. *Personality and Social Psychology Review, 6*(4), 316-325.

Shooter, W., Paisley, K., & Sibthorp, J. (2010). Trust development in outdoor leadership. *Journal of Experiential Education, 33*(3), 189-207.

Sibthorp, J., & Jostad, J. (2014). The social system in outdoor adventure education programs. *Journal of Experiential Education, 37*(1), 60-74.

Snijders, T.A.B., & Bosker, R.J. (1999). *Multilevel analysis: An introduction to basic and multilevel modeling.* London: Sage

Spencer, J.P., & Perone, S. (2008). Defending qualitative change: The view from dynamical systems theory. *Child Development, 79*(6), 1639-1647.

Thelen, E., & Smith, L.B. (2006). Dynamic systems theories. In M. Damon & R.M. Lerner (Eds.), *Handbook of child psychology* (pp. 258-312). Hoboken, NJ: Wiley & Sons.

Vallacher, R.R., & Nowak, A. (1997). The emergence of dynamical social psychology. *Psychological Inquiry, 8*(2), 73-99.

Walsh, V., & Golins, G. L. (1976). *The exploration of the Outward Bound process.* Denver, CO: Colorado Outward Bound School.

Wells, M., Ruddell, E., & Paisley, K. (2006). Creating an environment for sportsmanship outcomes: A systems perspective. *Journal of Physical Education, Recreation, and Dance, 77*(7), 13-17.

Wiese, S.L., Vallacher, R.R., & Strawinska, U. (2010). Dynamical social psychology: Complexity and coherence in human experience. *Social and Personality Psychology Compass, 4*(11), 1018-1030.

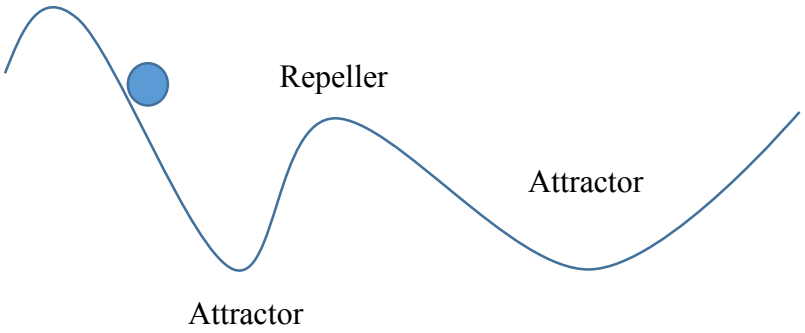

Figure 3.1. Basins of Attraction.

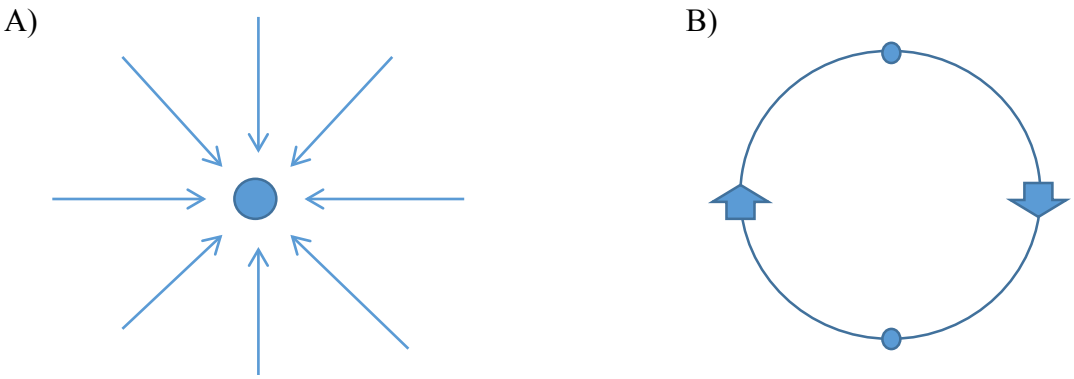

Figure 3.2. Fixed Point (A) and Limit Cycle (B) Attractors.

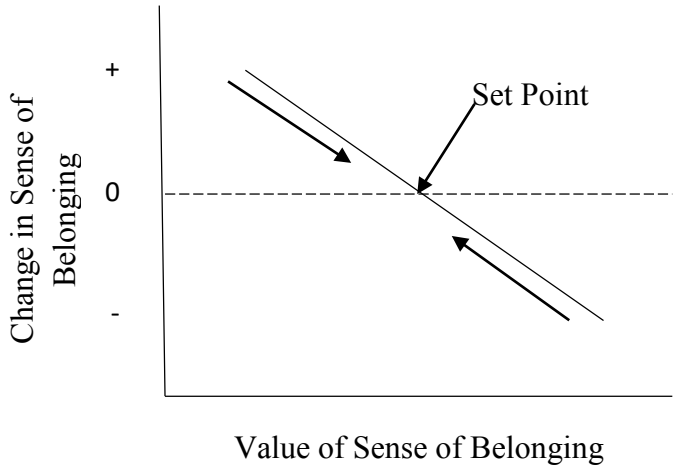

Figure 3.3. Graphical Representation of an Attractor.

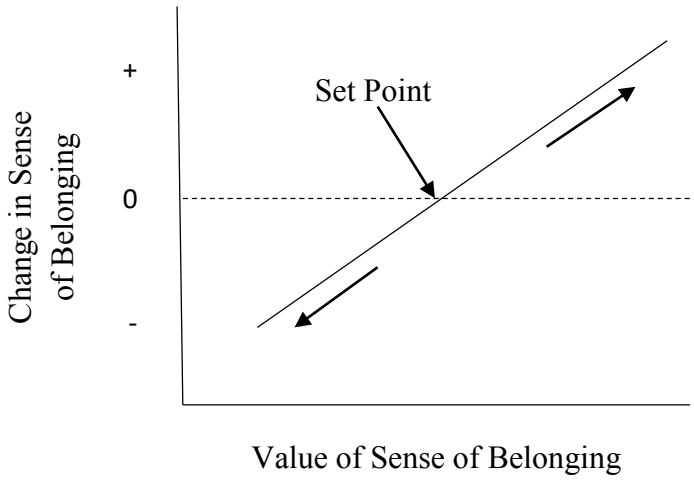

Figure 3.4. Graphical Representation of a Repeller.

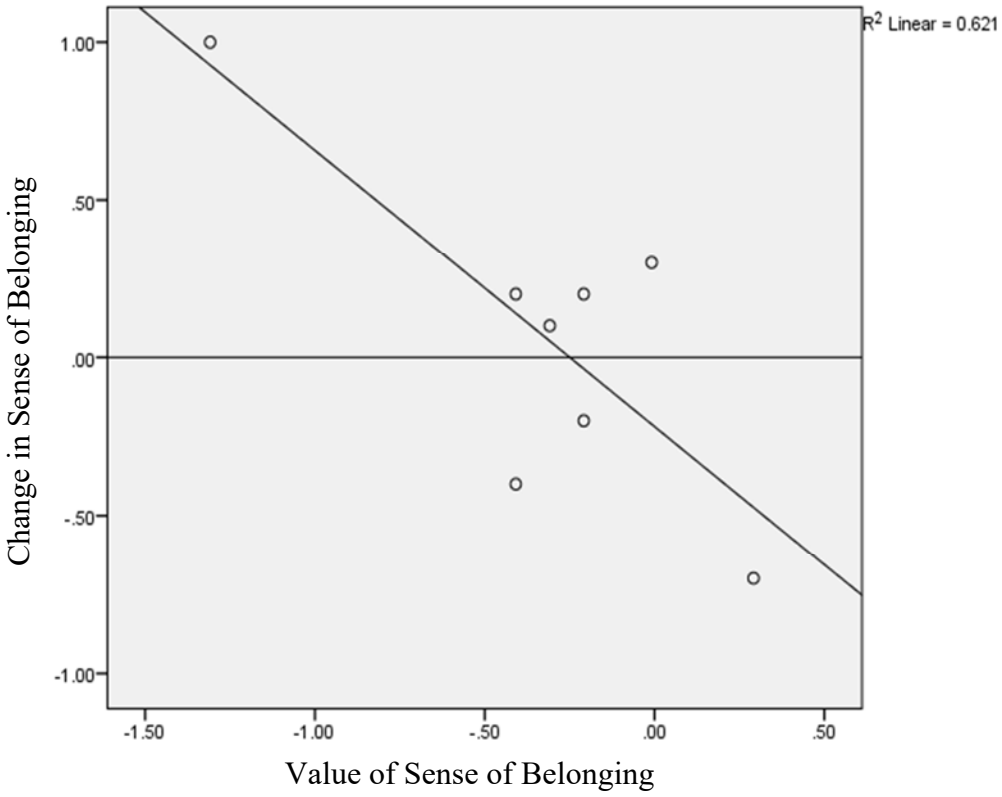

Figure 3.5. Tim's Relationship Between Current Sense of Belonging and Change.

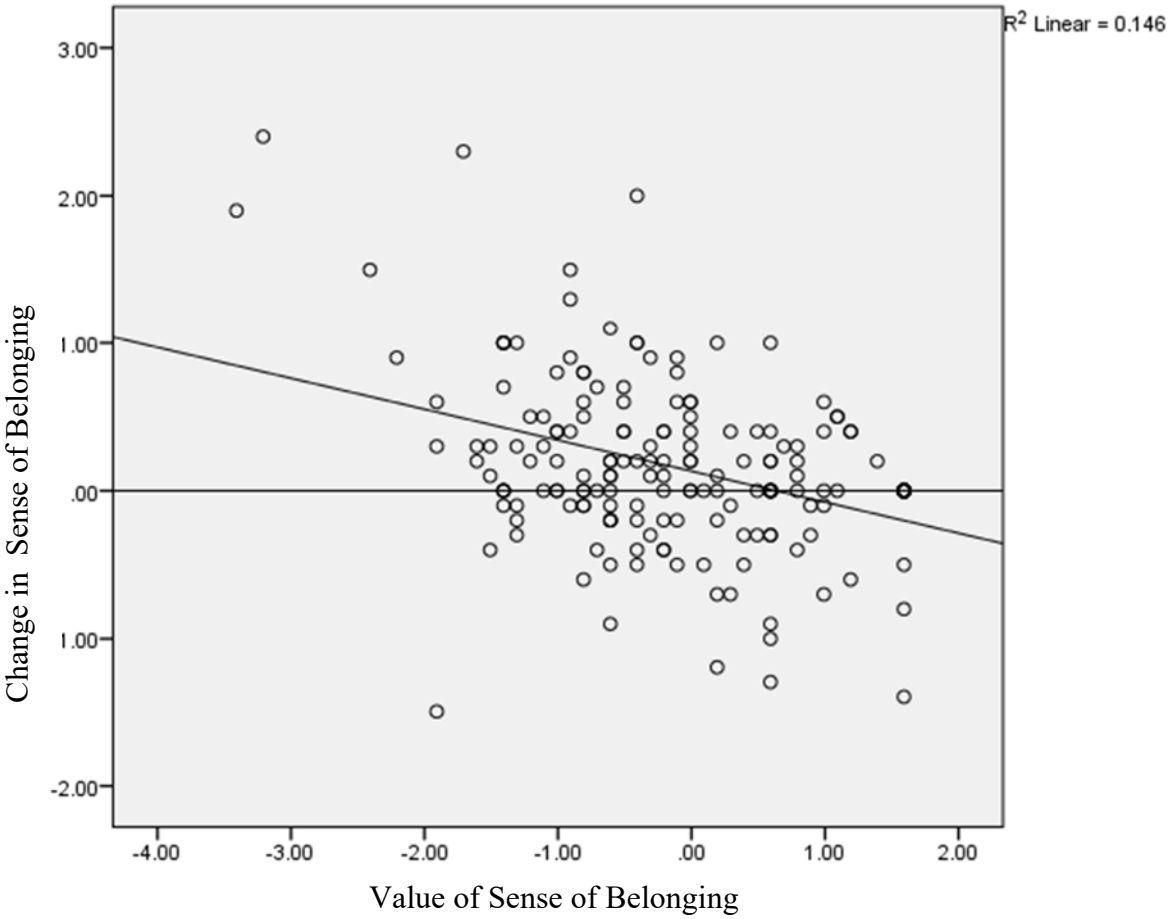

Figure 3.6. The Average Relationship Between Current Sense of Belonging and Change.

CHAPTER 4

UNDERSTANDING THE DYNAMICAL NATURE OF SOCIAL CONNECTIONS FOR ADOLESCENTS IN OUTDOOR RECREATION PROGRAMS

Abstract

Outdoor recreation programs are strategically positioned to provide a multitude of social outcomes for youth. The social connections adolescents develop with their peers are critically important for positive youth development. This study sought to understand how social connections develop within a wilderness-based outdoor recreation program. Using a dynamical systems theory framework and analysis, the findings showed a single stable point that students converged upon over time. Process conflict was found to alter how fast students converged and increased the stability of this point. Instructor support increased the value of this stable point.

Introduction

Adolescence is a developmental stage when many young people struggle with personal aspects such as self-confidence, self-concept, identity, and social development (Alaskar & Kroger, 2006). During this process, peers play a major role in how these different aspects of the self develop (Scholte & Van Aken, 2006). Recreation programs designed to serve adolescents are in a strategic position to help this developmental process because they often require students to interact in small cooperative groups (youth

sports, summer camps, outdoor and adventure programs). One outcome that is particularly important for adolescents is how they socially connect with their peers; however, little is known about how these social connections develop in recreation programs.

Dynamical systems theory (DST) may be one way to better understand developmental patterns. This developmental theory recognizes the complex interactions between multiple components within a system. Rather than measuring every component within the system and trying to understand the linear effects between components, the goal is to track the temporal pattern, or change, of phenomena under study (Vallacher, Read, & Nowak, 2002). These temporal patterns are depicted by markers of stability (attractors) and instability (repellers). The complex interactions between the components of recreation programs, such as instructors, students, activities, and the physical environment, provide an appropriate venue to implement DST.

Social Connections

Creating social connections with peers is imperative for adolescents as they develop toward adulthood. The need to feel psychologically and emotionally connected to others has remained of interest to both youth research and practice. However, a variety of constructs (e.g., sense of community, social cohesion, group identification, relatedness, sense of belonging) have been used within the literature to explain this phenomenon. For example, McMillan and Chavis (1986) define sense of community as "a feeling that members have of belonging, a feeling that members matter to one another and the group, and a shared faith that members' needs will be met through their commitment to be together" (p. 17). Others have described relatedness as the need "to feel securely

connected with others in the environment and to experience oneself as worthy of love and respect" (Osterman, 2000, p. 325). Sense of belonging has also been defined as "being accepted, valued, included, and encouraged by others" (Goodenow, 1993, p. 25). All of these constructs share conceptual and definitional overlap, sometimes even being used interchangeably. For the purposes of this paper, social connections will be operationalized under the construct of sense of belonging.

Baumeister and Leary's (1995) seminal article suggests that humans have a fundamental motivation to belong and describe their belongingness hypothesis as "the drive to form and maintain at least a minimum quantity of lasting, positive, and significant interpersonal relationships" (p. 497). There are two criteria that are necessary for humans to meet this motivation. First, people must have frequent and affectively pleasant interactions with a few others. Second, interactions must be temporally stable and show affective concern for each other. These criteria suggest that people must interact with others on a timely basis and that these interactions emit some type of emotional response. Baumeister and Leary go on to suggest that many of the strongest emotions people experience, which can be positive and negative, are a result of a feeling of belongingness.

Another conceptualization of belonging that aimed to provide an interdisciplinary approach to the construct suggested that belonging is comprised of five components: subjectivity, groundedness, reciprocity, dynamism, and self-determination (Mahar, Cobigo, & Stuart, 2013). Subjectivity is a perception unique to the individual that focuses on feelings of value, respect, and fit. These feelings must be grounded within a referent group, which for adolescents is often their peers. Reciprocity suggests that

individuals must share a sense of connectedness with one another, often based on shared experiences, understandings, and beliefs. Due to the dynamic nature of the physical and social environments, sense of belonging is a construct that changes over time. Lastly, they suggest that choice and power in determining a sense of belonging is important for individuals. Ultimately, they characterize sense of belonging as "a subjective feeling of value and respect derived from a reciprocal relationship to an external referent that is built on a foundation of shared experiences, beliefs or personal characteristics (p. 1031). This conceptualization provides a fruitful foundation on which to better understand the aspects involved in the development of belonging for adolescents.

Erikson (1968) suggests individuals move through a series of psychosocial roles as they develop. He argues that adolescents battle between identity and role confusion. Ultimately, adolescents are seeking a definition of self and the medium through which they define and take on this task is through their social group, or peers (Norlin, Chess, Dale, & Smith, 2003). Therefore, the subjectivity of feeling a sense of belonging for adolescents is often grounded in the context of their peers. Lacking a feeling of belonging could lead to social isolation, alienation, and loneliness, which suggests there is not a reciprocal feeling between individuals (Norlin et al., 2003). Lastly, we know that the context of belonging matters and that it is inherently dynamic. For example, an adolescent may have a strong sense of belonging on their club sports team, but this may not exist within their school environment. An adolescent will often be more competent and successful in the environment where they feel a stronger level of belonging (Osterman, 2000).

The school environment is one arena that has placed more importance on understanding belonging because this is where adolescents interact most frequently with their peers. Osterman (2000) provided a comprehensive look at the importance of sense of belonging for youth in the school setting. Her findings show that students who experience stronger levels of belonging are more motivated, committed, and engaged in the learning process. These findings also align with others who have looked at academic motivation and performance levels in regards to feelings of belonging (Becker & Luthar, 2002). When adolescents feel accepted, higher quality relationships are able to develop, and these types of interpersonal skills can be developmentally beneficial when transferred outside of the school context (Osterman, 2000).

Other outcomes that have been shown to result from feelings of belonging are increased psychological well-being (Riediger & Freund, 2004; Van Ryzin, Gravely, & Roseth, 2009) and efficacy beliefs (Faircloth & Hamm, 2005), along with decreased stress, anxiety, and self-consciousness (Goodenow, 1993). These outcomes are especially important for adolescents as they seek to understand and develop their own identity. One area that is primed to provide these types of benefits for adolescents is recreation programs.

Sense of Belonging and Recreation

There are a variety of recreation programs that are well suited to help adolescents develop a sense of belonging (e.g., summer camps and youth sports) and outdoor recreation programs (ORPs) have explicitly been tied to a variety of social outcomes for adolescents (Norton & Watt, 2014). Outdoor recreation programs bring disparate individuals together to form a group in a natural environment (most often wilderness),

who are then given problem-solving tasks or challenges to overcome. The nature of these programs provides a venue for social development and belonging. Dean and Harre (2013) describe the small group social setting as an intense social experience where "participants can assume different social roles, explore new behaviors, and gain feedback by observing the consequences of their actions" (p. 299). This type of setting allows for the development of many types of social outcomes such as prosocial behaviors (Furman & Sibthorp, 2014), character development (Goldenberg, McAvoy, & Klenosky, 2005), responsibility and commitment (Norton & Watt, 2014), social competence (Allison & Von Wald, 2010), and communication (Paisley, Furman, Sibthorp, & Gookin, 2008). Sense of belonging, while similar to other social connectedness constructs such as group cohesion have also been found to occur in ORPs (Eys, Ritchie, Little, Slade, & Oddson, 2008; Glass & Benshoff, 2002; Mirkin & Middleton, 2014). However, what is less understood are the factors that contribute to sense of belonging and how it develops over time in the context of ORPs.

Researching social development variables in the context of ORPs can be challenging because of issues due to sample size, instrumentation suitability, and the many variables that may influence development (Scrutton & Beames, 2015). Ewert and Sibthorp (2009) have noted that one of the challenges of research in ORPs is the presence of many confounding variables that can influence the findings within a study. It is well documented that ORPs are comprised of multiple components, such as the physical environment, social environment, types of activities, instructors, and students, which work together to produce rich learning experiences (McKenzie, 2000; Walsh & Golins, 1976). However, very few researchers recognize the multicomponent nature of these

programs and often do not have the means to control particular aspects of a study (Scrutton & Beames, 2015). Furthermore, there has long been a call within the literature to better understand the dynamic nature of the process within ORPs as opposed to just focusing on outcomes (McKenzie, 2000). This study takes on these challenges by using DST to theorize and model sense of belonging for adolescents.

Outdoor Recreation Programs as Dynamical Systems

The notion that ORPs are comprised of multiple components that interact with one another to produce particular outcomes has long been recognized (McKenzie, 2000; Walsh & Golins, 1976). Many of the common components include a novel physical environment, a small social group, the challenges or activities that are programmed, the instructors leading the program, and the students who participate in the program. These components are common among most, if not all, ORPs.

The social group is an inherent component of the ORP experience and has also been recognized as consisting of multiple interacting parts. Ewert and Heywood (1991) suggest that the wilderness setting creates a unique social context because the group is composed of strangers, the group exists for a relatively short period of time, the group has no social history, the group will eventually disband, and "to be successful, members must interact and cooperate" (p. 593). Sibthorp and Jostad (2014) developed a model of the social group that recognized some of the main components within the social system, such as contextual factors, student factors, instructor factors, goals, group-level factors, and time. There are not one or two variables that can fully explain why one student connects better with another; rather, multiple variables interact simultaneously and contribute to this process. Dynamical systems theory recognizes the complex interactions

between multicomponent systems and holds a different set of assumptions than the traditional research paradigm.

The primary task of DST is to track the developmental patterns, or change, in the phenomena under study (Wiese, Vallacher, & Strawinska, 2010). Rather than assuming that one component within the system is what creates or "causes" the outcome variable to change, DST recognizes that multiple components interact with one another to produce such changes. One of the primary foundations of DST is the notion of self-organization, which suggests that system-level behavior occurs through the interactions of the components within the system (Thelen & Smith, 2006). A unique aspect of self-organizing systems is the concept of emergence, meaning system-level behavior develops spontaneously through the interaction of the components within the system (DiDonato, England, Martin, & Amazeen, 2013). The overall system does not guide or tell the components how to interact; rather, patterns emerge through these interactions.

There are a variety of personal and interpersonal phenomena that exemplify emergent behavior; for example, group norms or public opinions often develop due to the spontaneous coordination of individuals' actions and beliefs (Vallacher et al., 2002). In the context of sense of belonging, the emergent feeling may be a result of individuals' personalities, goals they have for the course, or their perception of support from their instructors. The way these components interact can change the pattern of the emergent phenomena. Within DST, the system-level emergent behavior is known as an order parameter.

Order parameters can be thought of as dependent variables in the sense that they are the phenomena that are trying to be understood. However, order parameters are

unique to DST because they must also exhibit a level of change that exemplifies the development of the system. In addition, order parameters also provide an understanding of the system in relation to their own change (Vallacher & Nowak, 1997). Fundamentally this suggests that order parameters are determined by their previous points in time.

Another key difference of DST is causality. Rather than suggesting that a single component within the system causes a particular pattern, DST uses the notion of stability (attractors) and instability (repellers) to describe the changes within the system. Although many types of system behavior may exist (which is represented as the state space), systems typically only exhibit a few behaviors (Thelen & Smith, 2006). Thus, attractors represent where the order parameter tends to gravitate, whereas repellers represent where the order parameter tends to move away. For example, an adolescent on an ORP may typically gravitate toward higher levels of sense of belonging and be repelled by feelings of isolation and loneliness. However, there are a few components within the system that may be able to change this pattern.

A control parameter is a component within the system that has the ability to alter the level of attraction or repulsion and where attractors and repellers may exist within the state space (Butner, Gagnon, Guess, Lessard, & Story, 2015). Control parameters can be likened to independent variables, however, control parameters are those that interact with the system to produce qualitatively different patterns. Distinguishing between perturbations and control parameters is important in DST. Perturbations are small interactions within the system and knock the order parameter around the attractor state, but they do not alter the temporal pattern or attractor states (Butner et al., 2015). For

example, the natural elements (rain, snow, sun, mosquitoes) may act as a perturbation for a student's sense of belonging. This means that these natural elements do not drastically change the stable point which they gravitate toward, but may contribute to small fluctuations around this stable state. However, conflict within the group may act as a control parameter because this could potentially alter the pattern of belonging for an adolescent on an ORP.

Therefore, this paper will use DST to conceptualize and model how students develop social connections in the context of ORPs. Using the Sibthorp and Jostad (2014) model of the social group as a framework, three control parameters will be used to better understand the development of sense of belonging: goal conflict, process conflict, and instructor support. Although there may be other control parameters that influence sense of belonging, like personality characteristics, we bound the system to the context of these parameters.

Control Parameters

Control parameters can alter the temporal patterning of phenomena. Within a system, there are generally only a few control parameters that can alter this pattern. In this study, we modeled two forms of conflict and instructor support.

Conflict

All groups exhibit some form of conflict and conflict often plays an important role in how members of a group relate to one another (Levine & Thompson, 1996). Conflict exists when there is disagreement, discord, and friction of the actions or beliefs between individuals, which can cause detriment to the interpersonal relationships within

the group (Wilmot & Hocker, 2007). Though conflict has been recognized as a fruitful aspect of groups in regards to decision-making and problem solving (Levine & Thompson, 1996), it can also be detrimental to the development of relationships and identification of individuals within a group (Myers & Anderson, 2008).

There are multiple types of conflict that have been recognized but two of the most common that occur are goal and process conflict. Goal conflict occurs in relation to the outcomes members want within groups (Slocum, Cron, & Brown, 2002), while process conflict is in reference to how work is completed within the group (Jehn & Mannix, 2001). One of the main reasons that conflict commonly exists in groups is due to the inherent interdependence of groups (Hackman & Katz, 2010). These two types of conflict were included in this study.

Though conflict may manifest for a variety of reasons, goals are one of the main aspects why groups develop conflict. Goals are the foundation for groups, and one of the main types of conflict is due to incompatible goals, which influences group member interaction (Anderson, Foster-Kuehn, & McKinney, 1996). Goal conflict is a construct developed from goal setting theory (Locke & Latham, 2002); however, this theory has mainly been applied to intrapersonal conflict and not to interpersonal conflict. We define goal conflict as a difference, or incompatibility, between the goals or outcomes that students on a course are seeking. Boudreaux and Ozer (2013) suggest that the empirical evidence for goal conflict is surprisingly limited, though the importance of the construct within contemporary motivation and social theories is evident. Chapter 2 of this dissertation showed that goal conflict was negatively related to how students connected with one another within both dimensions of group identification. Students participate in

ORPs for a variety of reasons and the social connections that develop may be a result of the commonality between these goals.

A second type of conflict is process conflict, which Jehn and Mannix (2001) define as "an awareness of controversies about aspects of how task accomplishment will proceed" (p. 239). While most studies look at the influence of conflict on group performance, there is also evidence that process conflict can negatively affect the feelings of belonging. In a meta-analysis of 116 studies, process conflict was shown to decrease member satisfaction and group cohesion (De Wit, Greer, & Jehn, 2012). Part of living in the wilderness in a group requires chores and work to be completed (cooking food, setting up the tent, collecting water, etc.). When students do not complete their work or do not contribute toward group objectives, the relationships between students were said to deteriorate.

Based on the theoretical foundations of the small group and sense of belonging literature, we believe that these two types of conflict are suitable control parameters. That is, these types of conflict should change the position and strength of the attractor. For example, when adolescents do not have the same beliefs or goals of others, this may change the position and strength of the attractor. When adolescents disagree about how work should be done within the group on a daily basis, this may also change the position and strength of the attractor. Another aspect of ORPs that is important for adolescents to feel a sense of belonging is the level of support provided by instructors.

Instructor Support

Instructors play a vital role on ORP courses and are often seen as taking on the role of teacher, guide, and mentor. However, instructors often fill the parent role for

adolescents and help them work through the difficulties of being away from home. The behavior or relationships instructors are able to develop with students may have an important role in helping them feel a sense of belonging during these experiences.

A similar concept in the educational literature is known as teacher support, which is the perception that students believe their teachers care for them and value them as individuals (Klem & Connell, 2004). There is a strong body of research in the educational literature that shows teacher support positively influences outcomes such as well-being, engagement, and motivation (Klem & Connell, 2004; Van Ryzin et al., 2009), however, the impact that it may have on students' sense of belonging in an ORP group is untested.

The ORP literature has long recognized the importance of the instructor to student outcomes (McKenzie, 2000). While the ORP literature has often focused on instructor skill sets such as technical competence, leadership, and decision-making abilities as important competencies (Priest & Gass, 2005), there is a need to better understand the impact that instructor support can have on student outcomes. Sibthorp, Paisley, and Gookin (2007) identified the need for instructors to have positive relationships with the students. They state, "participants need to feel they matter to program leaders or facilitators to feel safe and to allow for full participation" (p. 6). In their study, they found that instructor support was positively associated with learning communication. Others have also recognized the importance of the instructor. Mirkin and Middleton (2014) liken the instructor to a "social engineer" and suggest that when instructors provide more social support to members of the group, the social climate becomes more positive. Furthermore, Chapters 2 and 3 of this dissertation showed that considerate behaviors and support by the instructor were positively related to social connections. To better

understand the role of the instructor in regards to sense of belonging, the construct of instructor support will be used as a third control parameter.

Therefore, the purpose of this study was to understand how adolescent students develop a sense of belonging with others on ORP's through the theoretical lens of dynamical systems. The following hypotheses were tested:

- H1: Goal conflict will lower the set point and alter the stability of sense of belonging.
- H2: Process conflict will lower the set point and alter the stability of sense of belonging.
- H3: Instructor support will increase the set point and alter the stability of sense of belonging.

Methods

Data were collected during the summer of 2015 with the National Outdoor Leadership School (NOLS) from six 14-day adolescent backpacking courses. These courses took place in the Rocky Mountains and were programmed for the adolescent population. A total of 63 students, which included 40 males and 23 females between 14 and 15 years of age, took part in the study. Data were collected toward the end of each full day they were in the field by having students complete a questionnaire. Because of a day in town at the beginning and end of the course, data were collected for a total of 12 consecutive days. All data were returned to the branch immediately following the course.

Instrumentation

Sense of belonging was measured using the Feeling of Social Belonging Scale (Richer & Vallerand, 1998) and has shown strong reliability (.90). Conflict was measured with items written by the author. First, goal conflict was measured with the item that was used successfully in Chapters 2 and 3. Process conflict was measured with two items based on Jehn and Mannix's (2001) Intragroup Conflict Scale. Instructor support was measured using a modified 4-item subscale of the Classroom Life Scale (Johnson, Johnson, Buckman, & Richards, 1985), which was designed to measure instructor support. The conflict and instructor support question scaling was modified to align with the 7-point Likert type Feeling of Social Belonging Scale (see Appendix for all scales).

Analysis

To conduct a DST analysis, a change variable must be created because change is the outcome of interest. This was done by creating a difference score between each time point for each person, which then becomes the change that is being predicted. Multilevel modeling techniques were used with the Hierarchical Linear Modeling (HLM) program in order to manage missing data and account for variance within and between individuals.

One of the main premises of DST is that the initial states of the system will predict the future states of the system (Howe & Lewis, 2005). Therefore, the current value of sense of belonging was used to predict its own change, which serves as the baseline model within DST. This simple equation provides information about attractors, repellers, and their strength. For example, Figure 4.1 shows the change in sense of belonging being predicted by its current value (all predictor variables have been grand-

mean centered). From this graph, it is possible to identify an attractor, the set point value for the attractor, and the relative strength of the attractor. In addition, this equation alone accounts for 12% of the variance in these data. The negative sloping line indicates attractive behavior. The point that this line crosses the zero point of change is called the set point, which denotes the stable state of the system.

Following the analysis techniques and equations used in Chapter 3, it is possible to identify the set point of our baseline model with the following equation:

$$0 = -b_0 / b_1$$

Given this equation and the values of the intercept and the slope, the set point for this baseline model is (–(0.07)/-0.44), which equals 0.16. That is, on an average day the attractor in this model stabilized 0.16 units above the grand mean of sense of belonging with a rate of change of 0.44. This model explains how students change over time from their current level of sense of belonging. When a student's level of belonging is below the value of 0.16, he/she develops a stronger sense of belonging over time. Conversely, when students are above the set point value, their level of sense of belonging will decrease until it stabilizes at a value of 0.16.

Students will most likely develop a sense of belonging at different rates and have different set points. Variance components were included when modeling both intercepts and slopes and both were found to be significant ($p < .001$), which suggests that students both vary in the strength of attraction and location of their set points. In order to understand how and if control parameters influence the change in sense of belonging,

control parameters were added as a main effect and an interaction with the current value of sense of belonging. The full mixed multilevel model equation is:

$$\text{Change of Belonging}_{ti} = \beta_{00} + \beta_{01}*\text{Goal Conflict}_i + \beta_{02}*\text{Instructor Support}_i + \beta_{10}*\text{Current Belonging}_{ti} + \beta_{11}*\text{Goal Conflict}_i*\text{Current Belonging}_{ti} + \beta_{12}*\text{Instructor Support}_i*\text{Current Belonging}_{ti} + \beta_{20}*\text{Process Conflict}_{ti} + \beta_{30}*\text{Process Conflict X Current Belonging}_{ti} + r_{0i} + r_{1i}*\text{Current Belonging}_{ti} + e_{ti}$$

Results

Process conflict was added as a level-1 control parameter and as an interaction with the current level of sense of belonging. Process conflict did not have a significant main effect ($\beta = -0.02$, $p = .45$), but did have a significant interaction ($\beta = -0.03$, $p = .03$). This negative coefficient suggests that for every 1-unit increase in process conflict on an average day, a student's sense of belonging becomes more attractive. That is, the slope of the equation becomes steeper as a result of this interaction, suggesting that students with higher levels of process conflict move toward the set point at a faster rate.

Goal conflict and instructor support were added as level-2 control parameters and as an interaction with the current level of sense of belonging. Goal conflict ($\beta = -0.03$, $p = .26$) and the goal conflict by current level of sense of belonging interaction ($\beta = 0.02$, $p = .41$) were not significant control parameters. However, instructor support ($\beta = 0.20$, $p < .01$) had a significant main effect on the change of sense of belonging. The positive coefficient suggests that for every 1-unit increase in instructor support, a student increases by 0.20 units. There was not a significant interaction for instructor support ($\beta = -0.04$, $p = .35$).

As discussed in Chapter 3, effect size calculations in multilevel models can take a variety of forms (Peugh, 2008). This chapter follows the recommendation of Snijders

and Bosker (1999) by using the predicted and residual values of the model to calculate the overall model effect size. The predicted standard deviation (PREDSD) and residual standard deviation (RESSD) were used to calculate the effect size using the following equation:

$$ES = PREDSD*PREDSD/ ((PREDSD*PREDSD) + (RESSD*RESSD))$$

Using this equation, this DST model accounted for 29% of the variance in the change of sense of belonging.

Discussion

This research was exploratory in the sense that this was the first time, to our knowledge, of modeling data using a DST lens in ORP research. The use of DST requires a different set of assumptions, a different way of looking at phenomena, and a different way to explain behavior than the traditional paradigm. The purpose of this chapter was to better understand the development of social connections for adolescents within ORPs. The use of DST provides a framework to take on the challenges of the many interacting variables when studying this complex system.

Baseline Model

The baseline model in a DST model is the current level of a variable predicting its own change. This baseline is important because it depicts the behavior of the order parameter through time. These data exhibited a single fixed point attractor that students gravitate toward over time. The values in these data have been grand-mean centered to provide a better understanding of the data. In raw metric, the attractor in the baseline

model is a value of 5.9 on a 1-7 point scale. Therefore, these data suggest that on average students move toward a fairly high level of sense of belonging over time. Understanding what influences this baseline pattern can be understood when adding control parameters to the model.

Conflict

Though conflict is generated through a variety of means (Levine & Moreland, 2006), we specifically modeled goal and process conflict. In the previous two chapters of this dissertation goal conflict had a significant relationship to social connection and the change of social connection. A variety of studies have shown that goal conflict is associated with negative affect (Bodreauxs & Ozer, 2013), decreased performance (Slocum, Cron, & Brown, 2002), and decreased psychological well-being (Riedeger & Freund, 2004). These data did not show a significant relationship with goal conflict and this may have occurred for two possible reasons. First, a 14-day course is very different than a 30-day course. Students on a 14-day course may not have well-articulated goals because of the limited time they are in the field. Crane, Hattie, and Houghton (1997) conducted a study that looked at goal setting and found that many goals students possessed were vague and not specific. However, students who participate in 30-day courses have ample time to work on a variety of goals that could not be achieved on shorter courses. For example, navigation is a common goal for both types of courses. Unfortunately, students on a 14-day course may have only eight or nine days to work on this, which is a short period of time to develop navigations skills. Students on a 30-day course may have more than 25 days to work on this skill. Fundamentally, shorter course lengths limit what students can realistically learn.

Another reason why there may not have been a significant relationship was because the outcome variable in a DST study is change. Ultimately, goal conflict may be negatively associated with a student's sense of belonging, but a DST analysis is interested in the change of a student's sense of belonging. That is, the outcome is change and not a mean value of sense of belonging. This requires a different way to think about the phenomena under study. These data suggest that goal conflict acts as a perturbation to the system, meaning it tends to knock the order parameter around its attractor state, but does not qualitatively change the set point or strength of the attractor state.

There are two different theoretical views about the role process conflict plays in groups. One view suggests that process conflict deteriorates relationships within groups and limits the goals that the groups are able to achieve (Behfar, Mannix, Peterson, & Trocum, 2011; de Wit et al., 2012). Another view suggests moderate levels of process conflict actually benefits members of groups by increasing performance and strengthening relationships (Jehn & Mannix, 2001; Kellermanns & Eddleston, 2004). Given the context and population of this study, we theorized that process conflict would decrease the set point of sense of belonging. However, process conflict did not have a main effect on the change of sense of belonging, which suggests that the set point value did not negatively or positively change for students.

What is interesting in these data, and is often of most interest in DST analyses, is the interaction control parameters have with the current level of sense of belonging. The significant interaction between process conflict and a student's current level of sense of belonging suggests two differences to the change in sense of belonging. First, the rate students moved toward the attractor increased when students had higher levels of daily

process conflict. Second, the strength of the attractor increased and suggests that this attractor becomes more stable. Thus, students who have more daily process conflict are more likely to hover around their attractor state despite perturbations within the system. Furthermore, the significant random effect also suggests that students have both "high" and "low" set points.

One possible explanation of these data is to consider that moderate levels of process conflict may be the means that stabilize students at a particular level of belonging. These data suggest that students who have higher levels of process conflict move to a particular level (attractor) of sense of belonging at a faster rate than students with lower levels of process conflict. Since students vary in their set point, process conflict can actually move students toward both "high" and "low" set points. That is, process conflict can be helpful for students if they have "high" set points, but it can also have a negative effect when it moves students toward "low" set points. Therefore, students with higher levels of process conflict move toward their attractor faster. Their attractor also becomes more stable, and thus more difficult to change. When attractors become more stable, students are less likely to be "pushed off" of the attractor by perturbations within the system. Therefore, process conflict allows students to "lock in" on both high and low levels of belonging.

These findings support both theoretical views of process conflict. That is, for some students process conflict can be beneficial, but for others it may be detrimental to the development of belonging.

We are not advocating that process conflict should be intentionally programmed into ORPs. Process conflict should occur due to the natural characteristics of the course.

Furthermore, adolescents may also need help from their instructors to process, communicate, and work through the challenges that process conflict may create. Others have also found that process conflict can be beneficial when the conflict is resolved early in the process and not left to linger throughout the life of a group (Jehn & Bendersky, 2003).

In the context of an ORP, process conflict can occur between students over who is expected to set up the tent, what food should be cooked for dinner, or how to hang the bear bag. If left unresolved, these small but important issues may actually have a negative influence on the development of social connections. However, instructors can help students resolve these conflicts by providing communication and problem solving assistance. When instructors help in this manner, process conflict may be a catalyst for the development of social connections. Furthermore, these actions by an instructor may also show a level of support and care the instructor has for the students.

Instructor Support

There is a plethora of ORP and educational literature that notes the importance of the instructor in a variety of social outcomes for students (Mirkin & Middleton, 2014; Schumann, Paisley, Sibthorp, & Gookin, 2009). While instructors on ORPs are expected to fulfill a variety of needs for programs and students, the level of support they should provide is often overlooked. Providing this support is important in the context of ORPs because students are in a completely new physical and social environment. For many students, this is their first time away from home and among a new peer group.

The significant positive main effect increased a student's level of social belonging by 0.20 units for every 1-unit increase in instructor support. Therefore, the location of

the attractor (the stable value of sense of belonging) increased. This main effect does not shift the rate of change, but only the location of the attractor. These findings support the importance that the instructor can play in helping students develop a sense of belonging on a course.

Others have found that the instructor plays a vital role in the development of interpersonal relationships by setting the tone for the group culture, role modeling positive behavior, and developing trust between students and instructors (Mirkin & Middleton, 2014; Shooter, Paisley, & Sibthorp, 2010). While the instructor has long been recognized as an important component of ORPs, the role that instructors are expected to fill is slowly changing. Traditionally instructors have been highlighted as needing great technical skill, decision making ability, and physical prowess (Priest & Gass, 2005). However, continued research highlights that the social dimension is becoming just as important as the technical dimension for instructors. Program administrators need to consider effective training practices that will help instructors provide students support as needed.

Limitations

This study was conducted using a DST lens because of the complex and changing nature of social connections within the context of ORPs. Dynamical system models are models of change and it is vital to have an order parameter that exhibits change. One of the reasons that goal conflict failed to be significant may be due to the relatively minor change in social belonging over the length of the course. The more change the order parameter exhibits, the more there is to explain, and this provides a more interesting description of the system.

Another limitation of this research was that linear equations were used to model these data. Researchers may also want to consider the nonlinear nature of dynamical systems and use quadratic and cubic equations in their analyses. For example, these data can also be described by a nonlinear cubic equation when observing the time series of sense of belonging. Figure 4.2 shows the cubic form of the time series and exhibits the nonlinear development of sense of belonging. This shows that the beginning and end of the course is where the majority of the change in sense of belonging occurs. Figure 4.3 shows the same attractor as Figure 4.1, but by using a cubic form of the equation. While the set point is the same, how students move toward the set point is nonlinear. Furthermore, this nonlinear form explains 16% of the variance as opposed to the 12% of the linear attractor. The further away students are from the set point, the faster they change, but as they near the set point, their change is much slower.

One last limitation of this research is that this system exhibited only one attractor. However, some systems can show multiple attractors within their phase space known as multistability. For example, Figure 4.4 shows a hypothetical possibility for two stable states within this phase space. The two negative sloping lines that cross the point of no change are the set points (attractors) and the positive sloping line is the repeller. In some cases a phase space may demonstrate two or more stable attractors that a person may gravitate toward, which provides a more fruitful description of a complex system.

Conclusion

Little is known about the development processes for many outcomes in ORPs. This research highlights the development of social connections for adolescents participating in ORPs and uses a DST lens to take on some of the challenges of

researching ORPs. By using a DST model, it is possible to understand how a student's sense of belonging changes given their current feeling of sense of belonging and how certain control parameters within the system alter this pattern.

Conflict is inevitable when working with others and there are many forms of conflict that can exist between individuals. Though goal conflict was not statistically significant, it acts as a perturbation to the system. Process conflict showed that it altered the rate of change and strength of the attractor in the system. Viewed in this context, one explanation of this result may suggest that moderate levels of conflict, when facilitated appropriately, may help students develop social connections. This study also showed the importance for instructors to provide high levels of support with adolescent students. Program administrators should provide training and resources for staff to develop supportive behaviors and skills to help resolve conflict.

References

Alaskar, F.D., & Kroger, J. (2006). Self-concept, self-esteem, and identity. In S. Jackson & L. Goosens (Eds.), *Handbook of adolescent development* (pp. 90-117). New York, NY: Psychology Press.

Allison, P., & Von Wald, K. (2010). Exploring values and personal and social development: Learning through expeditions. *Pastoral Care in Education, 28*(3), 219-233.

Anderson, J., Foster-Kuehn, M., & McKinney, B.C. (1996). *Communication skills for surviving conflicts at work.* Cresskill, NJ: Hampton Press.

Baumeister, R. F., & Leary, M. (1995). The need to belong: Desire for interpersonal attachments as a fundamental human motivation. *Psychological Bulletin, 117*(3), 497-529.

Becker, B. E., & Luthar, S. S. (2002). Social-emotional factors affecting achievement outcomes among disadvantaged students: Closing the achievement gap. *Educational Psychologist, 37*(4), 197-214.

Behfar, K.J., Mannix, E.A., Peterson, R.S., & Trochim, W.M. (2011). Conflict in small groups: The meaning and consequences of process conflict. *Small Group Research, 42*(2), 127-176.

Boudreaux,M.J., & Ozer, D.J. (2013). Goal conflict, goal striving, and psychological well-being. *Motivation and Emotion, 37*(3), 433-443.

Butner, J.E., Gagnon, K.T., Guess, D.A., Lessard, D.A., & Story, N. (2015). Utilizing topology to generate and test theories of change. *Psychological Methods, 20*(1), 1-25.

Crane, D., Hattie, J., & Houghton, S. (1997). Goal setting and the adventure experience. *Australian Journal of Psychology*, *49*, 6-13.

Deane, K.L., & Harre, N. (2013). The youth adventure programming model. *Journal of Research on Adolescence, 24*(2), 293-308.

De Wit, F. R., Greer, L. L., & Jehn, K. A. (2012). The paradox of intragroup conflict: A meta-analysis. *Journal of Applied Psychology*, *97*(2), 360-390.

DiDonato, M.D., England, D., Martin, C.L., & Amazeen, P.G. (2013). Dynamical analyses for developmental science: A primer for intrigued scientists. *Human Development, 56*, 59-75.

Erikson, E. H. (1968). *Identity: Youth and crisis.* New York, NY: Norton & Company.

Ewert, A., & Heywood, J. (1991). Group development in the natural environment: Expectations, outcomes, and techniques. *Environment and Behavior*, *23*, 592-615.

Ewert, A., & Sibthorp, J. (2009). Creating outcomes through experiential education: The challenge of confounding variables. *Journal of Experiential Education, 31*(3), 376-389.

Eys, M. A., Ritchie, S., Little, J., Slade, H., & Oddson, B. (2008). Leadership status congruency and cohesion in outdoor expedition groups. *Journal of Experiential Education*, *31*(1), 78-94.

Faircloth, B.S., & Hamm, J.V. (2005). Sense of belonging among high school students representing 4 ethnic groups. *Journal of Youth and Adolescence, 34*(4), 293-309.

Furman, N., & Sibthorp, J. (2014). The development of prosocial behavior in adolescents: A mixed methods study from NOLS. *Journal of Experiential Education, 37*(2), 160-175.

Glass, J.S., & Benshoff, J.M. (2002). Facilitating group cohesion among adolescents through challenge course experiences. *Journal of Experiential Education, 25*(2), 268-277.

Goldenberg, M., McAvoy, L., & Klenosky, D. (2005). Outcomes from the components of an Outward Bound experience. *Journal of Experiential Education, 28*(2), 123-146.

Goodenow, C. (1993). Classroom belonging among early adolescent students: Relationships to motivation and achievement. *The Journal of Early Adolescence, 13*(1), 21-43.

Hattie, J., Marsh, H.W., Neill, J.T., & Richards, G.E. (1997). Adventure education and Outward Bound: Out-of-class experiences that have a lasting effect. *Review of Educational Research, 67*(1), 43-87.

Hackman, J. R., & Katz, N. (2010). Group behavior and performance. In S.T. Fiske, D.T. Gilbert, & G. Lindzey (Eds.), *Handbook of social psychology* (pp. 1208–1251). San Francisco, CA: John Wiley & Sons, Inc.

Howe, M.L., & Lewis, M.D. (2005). The importance of dynamic systems approaches to understanding development. *Developmental Review, 25*, 247-251.

Jehn, K.A., & Bendersky, C. (2003). Intragroup conflict in organizations: A contingency perspective on the conflict-outcome relationship. In R. Kramer & B. Staw (Eds.) *Research in organizational behavior* (pp. 189-244). Amsterdam, Netherlands: Elsevier.

Jehn, K.A., & Mannix, E.A. (2001). The dynamic nature of conflict: A longitudinal study of intragroup conflict and group performance. *Academy of Management Journal, 44*(2), 238-251.

Johnson, D.W., Johnson, R.T., Buckman, L.A., & Richards, P.S. (1985). The effect of prolonged implementation of cooperative learning on social support within the classroom. *The Journal of Psychology, 119*, 405-411.

Kellermanns, F.W., & Eddleston, K.A. (2004). Feuding families: When conflict does a family firm good. *Entrepreneurship Theory and Practice, 29*(3), 209-228.

Klem, A.M., & Connell, J.P. (2004). Relationship matter: Linking teacher support to student engagement and achievement. *Journal of School Health, 74*(7), 262-273.

Levine, J.M., & Thompson, L. (1996). Conflict in groups. In E.T. Higgins & A. Kruglanski (Eds.), *Social psychology: Handbook of basic principles* (pp.745-776). New York, NY: Guilford.

Locke, E.A., & Latham, G.P. (2002). Building a practically useful theory of goal setting and task motivation. *American Psychologist, 57*(9), 705-717.

Mahar, A.L., Cobigo, V., & Stuart, H. (2013). Conceptualizing belonging. *Disability & Rehabilitation, 35*, 1026-1032.

McKenzie, M.D. (2000). How are adventure education program outcomes achieved?: A review of the literature. *Australian Journal of Outdoor Education, 5*(1), 19-28.

McKenzie, M.D. (2003). Beyond the "Outward Bound process:" Rethinking student learning. *Journal of Experiential Education, 26*(1), 8-23.

McMillan, D.W., & Chavis, D.M. (1986). Sense of community: A definition and theory. *Journal of Community Psychology, 14*, 6-23.

Mirkin, B.J., & Middleton, M.J. (2014). The social climate and peer interaction on outdoor courses. *Journal of Experiential Education, 37*(3), 232-247.

Myers, S.A., & Anderson, A.M. (2008). *The fundamentals of small group communication.* Thousand Oaks, CA: Sage.

Norlin, J.M., Chess, W.A., Dale, O., & Smith, R. (2003). *Human behavior and the social environment: Social systems theory* (4th ed.). Boston, MA: Allyn & Bacon.

Norton, C.L., & Watt, T.T. (2014). Exploring the impact of a wilderness-based positive youth development program for urban youth. *Journal of Experiential Education, 37*(4), 335-350.

Osterman, K.F. (2000). Students' need for belonging in the school community. *Review of Educational Research, 70*(3), 323-367.

Paisley, K., Furman, N., Sibthorp, J., & Gookin, J. (2008). Student learning in outdoor education: A case study from the National Outdoor Leadership School. *Journal of Experiential Education*, *30*(3), 201-222.

Peugh, J.L. (2008). A practical guide to multilevel modeling. *Journal of School Psychology, 48*, 85-112.

Priest, S., & Gass, M.A. (2005). *Effective leadership in adventure programming.* Champaign, IL: Human Kinetics.

Richer, S.F., & Vallerand, R.J. (1998). Construction et validation de l'Echelle du sentiment d'appartenance sociale (ESAS). *Revue Européenne de Psychologie Appliquée, 48*(2), 129-137.

Riediger, M., & Freund, A.M. (2004). Interference and facilitation among personal goals: Differential associations with subjective well-being and persistent goal pursuit. *Personality and Social Psychology, 30*, 1511-1523.

Scholte, R., & Van Aken, A.G. (2006). Peer relations in adolescence. In S. Jackson & L. Goossens (Eds.), *Handbook of adolescent development* (pp. 175-199). New York, NY: Psychology Press.

Schumann, S., Paisley, K., Sibthorp, J., & Gookin, J. (2009). Instructor influences on student learning at NOLS. *Journal of Outdoor Recreation, Education, and Leadership, 1*(1), 15-37.

Scrutton, R., & Beams, S. (2015). Measuring the unmeasurable: Upholding rigor in quantitative studies of personal and social development in outdoor adventure education. *Journal of Experiential Education, 38*(1), 8-25.

Shooter, W., Paisley, K., & Sibthorp, J. (2010). Trust development in outdoor leadership. *Journal of Experiential Education, 33*(3), 189-207.

Sibthorp, J., & Jostad, J. (2014). The social system in outdoor adventure education programs. *Journal of Experiential Education, 37*(1), 60-74.

Sibthorp, J., Paisley, K., & Gookin, J. (2007). Exploring participant development through adventure-based programming: A model from the National Outdoor Leadership School. *Leisure Sciences, 29*, 1-18.

Slocum, J.W., Cron, W.L., & Brown, S.P. (2002). The effect of goal conflict on performance. *The Journal of Leadership and Organizational Studies, 9*(1), 77-90.

Snijders, T.A.B., & Bosker, R.J. (1999). *Multilevel analysis: An introduction to basic and multilevel modeling.* London: Sage.

Thelen, E., & Smith, L.B. (2006). Dynamic systems theories. In M. Damon & R.M. Lerner (Eds.), *Handbook of child psychology* (pp. 258-312). Hoboken, NJ: Wiley & Sons.

Vallacher, R.R., Read, S.J., & Nowak, A. (2002). The dynamical perspective in personality and social psychology. *Personality and Social Psychology Review, 6*(4), 264-273.

Vallacher, R.R., & Nowak, A. (1997). The emergence of dynamical social psychology. *Psychological Inquiry, 8*(2), 73-99.

Van Ryzin, M.J., Gravely, A.A., & Roseth, C.J. (2009). Autonomy, belongingness, and engagement in school as contributors to adolescent psychological well-being. *Journal of Youth Adolescence, 38*, 1-12.

Walsh, V., & Golins, G. L. (1976). *The exploration of the Outward Bound process*. Denver, CO: Colorado Outward Bound School.

Wiese, S.L., Vallacher, R.R., & Strawinska, U. (2010). Dynamical social psychology: Complexity and coherence in human experience. *Social and Personality Psychology Compass, 4*(11), 1018-1030.

Wilmot, W.W., & Hocker, J.L. (2007). *Interpersonal conflict* (7th ed.). Boston, MA: McGraw Hill.

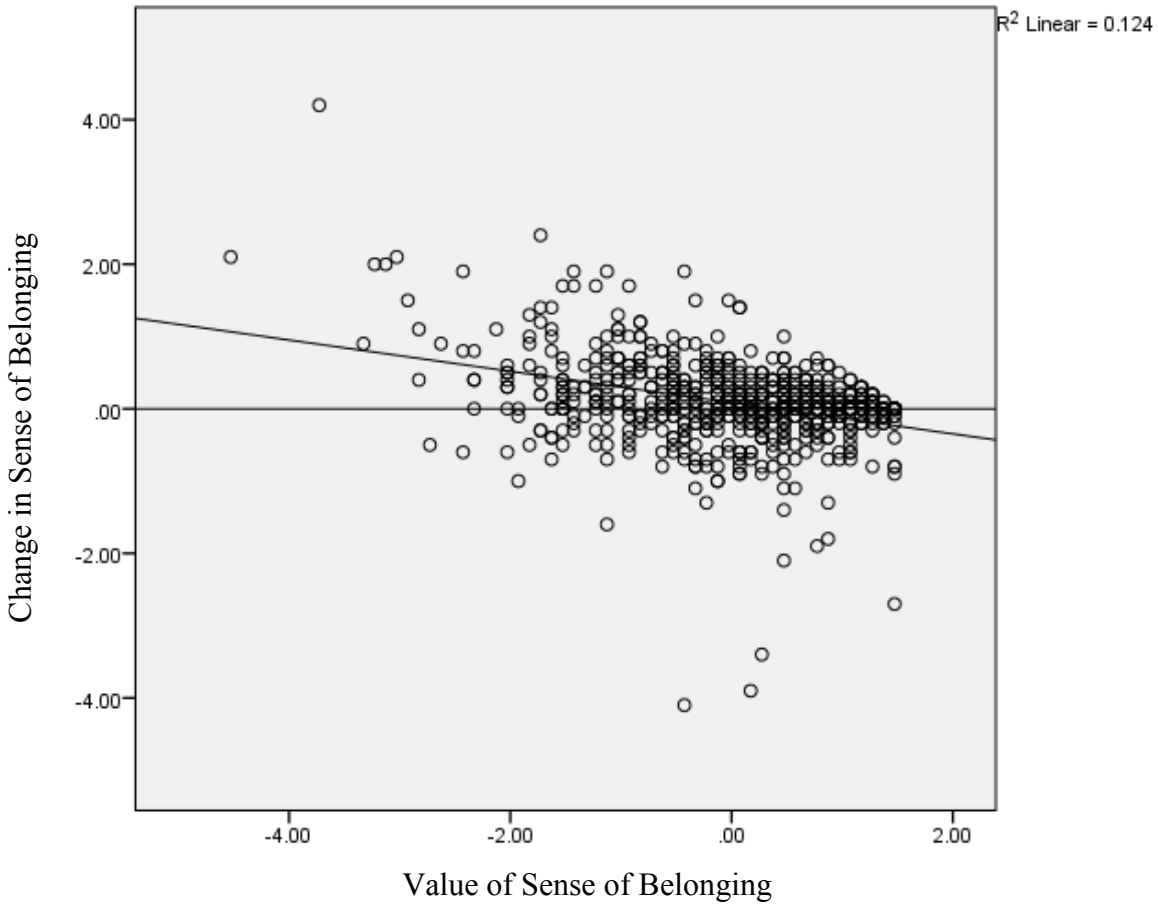

Figure 4.1. The Linear Relationship Between Current Sense of Belonging and Change.

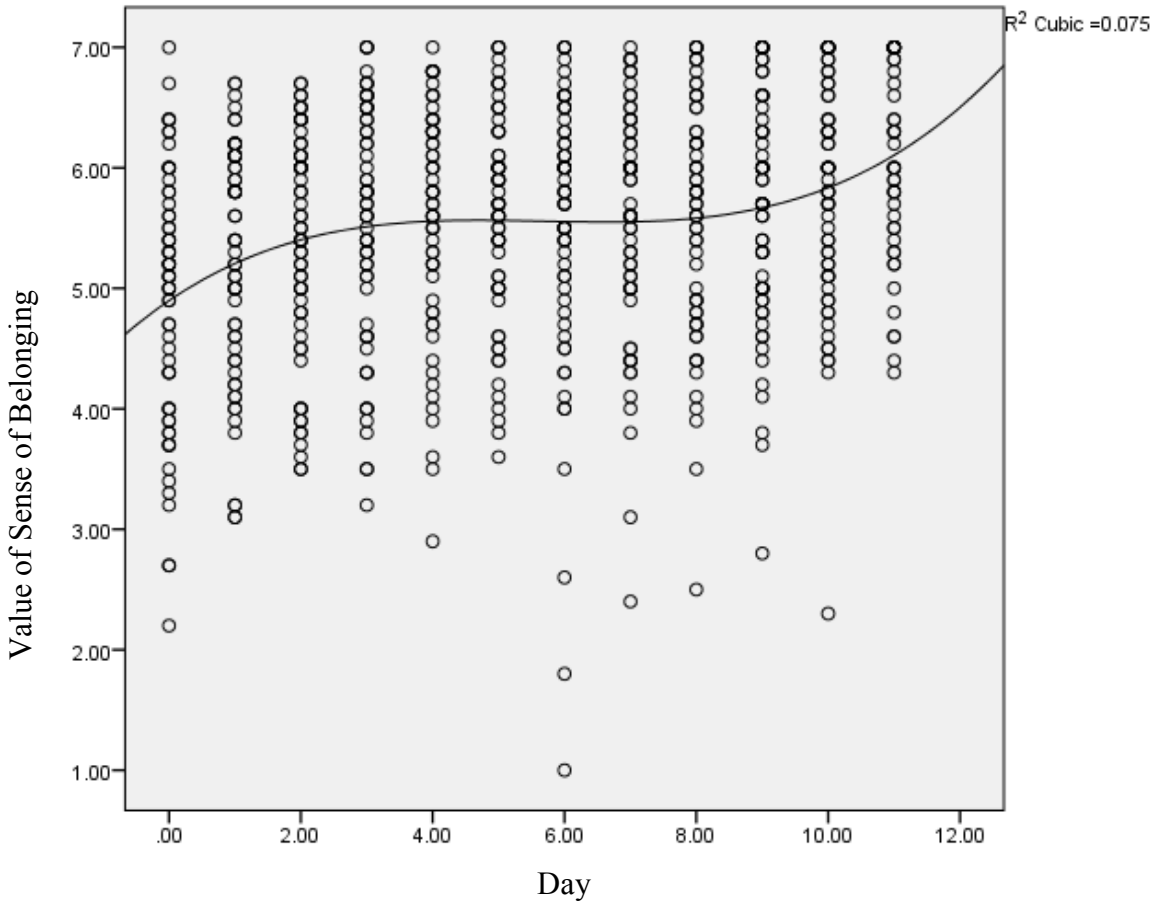

Figure 4.2. The Time Series of Sense of Belonging.

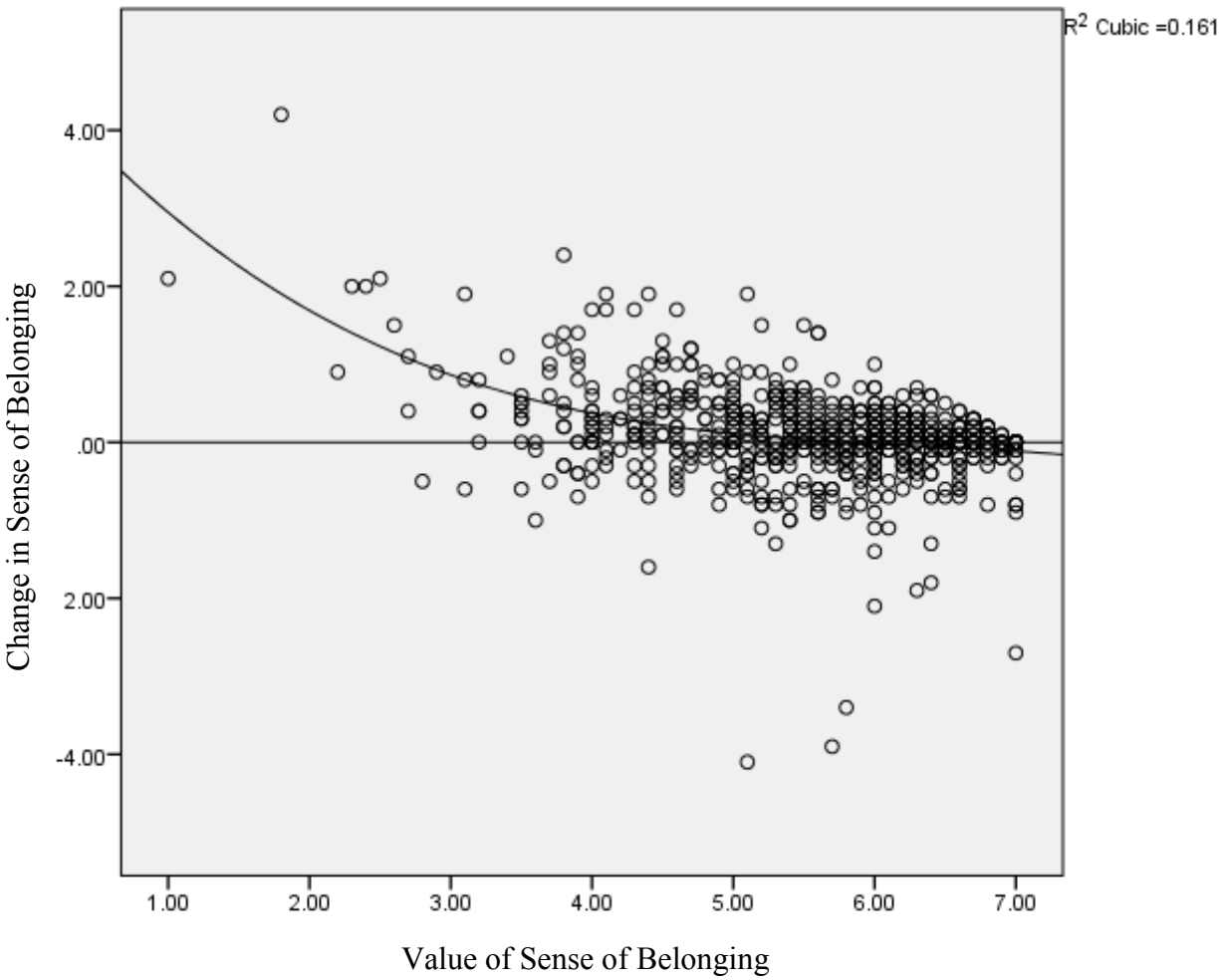

Figure 4.3. The Cubic Relationship Between
Current Sense of Belonging and Change.

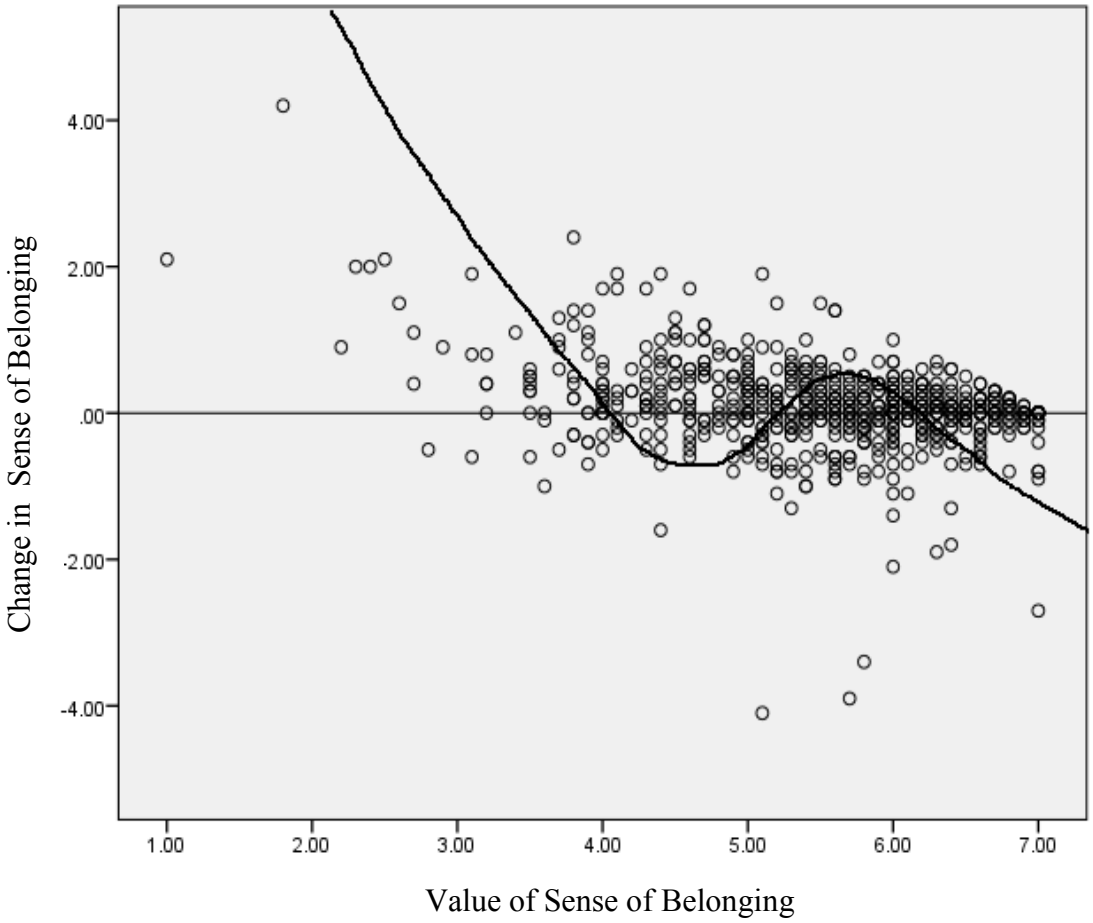

Figure 4.4. A Hypothetical Phase Space Representing Multistability.

CHAPTER 5

CONCLUSION

This dissertation used five chapters to better understand how social connections develop among adolescents in the context of outdoor adventure education (OAE) programs. Chapter 1 provided an introduction and argument for the dissertation. Chapter 2 used a model of the social group as a framework to try and understand key variables that were related to social connections. Chapter 3 presented the theoretical foundations of dynamical systems theory (DST) and demonstrated one way to model dynamical systems. Chapter 4 integrated the findings and theoretical aspects of Chapters 2 and 3 by completing a study that measured the development of social connections of 63 adolescents over 12 days on a course from the National Outdoor Leadership School (NOLS). Chapter 5 provided a conclusion to this study. Through these five chapters, a better understanding of the developmental trajectory of sense of belonging and some of the key components that alter this development were identified. Ultimately, this dissertation advocates for a DST perspective to capture the multicomponent and complex nature of the social setting within OAE programs.

Chapter 2 of this dissertation sought to understand some of the components of the social system that are related to the development of social connections. Based from a social system model in OAE, this chapter used a group identification theoretical framework to measure social connections. Student factors, instructor factors, goal factors, group factors, and time data were collected from 22 different groups participating in a 30-day NOLS course. The findings showed

that goal conflict, social status, leadership consideration, and sex ratio were significantly related to the affective dimension of group identification, however, only 8% of the variance between students in this model was explained. Goal conflict and social status were significant predictors for the cognitive dimension and accounted for 16% of the variance explained at the individual level. Surprisingly, social connections did not change from day 10, 20, and 30 of the course.

Chapter 2 provided a number of findings from which to build a better understanding of social connection. First, the timing of the measurements did not capture the developmental trajectory of social connection that was theorized. These data suggested that social connection may develop by day 10 of a course. Therefore, future studies that are trying to capture this development need to measure social connection well before day ten of a course. Second, while there were a variety of statistically significant predictors, there were relatively small effect sizes at the individual level. These small effect sizes were exacerbated by the fact that the majority of the variance was also at the individual level. Therefore, the majority of the differences in these data were between students and not between groups. In order to address these issues and acknowledge the complexity of the social group within OAE, a different theoretical perspective and method of looking at data were needed.

Chapter 3 of this dissertation introduced the theoretical foundations of DST and demonstrated one approach to modeling data. Dynamical systems theory recognizes that systems are comprised of multiple components that interact with one another to produce emergent phenomena (Thelen & Smith, 2006). Ultimately, the developmental, or spatio-temporal pattern that the system displays is of concern to the researcher. These spatio-temporal patterns are described by terms such as order parameters, control parameters, set points,

attractors, and repellers. All of these notions can be captured through familiar multilevel model equations, as was demonstrated using a "change as outcome" model.

In order to demonstrate this analysis technique, data from two NOLS semester courses were collected for the first nine days students were in the field. How to create the change variable, develop a baseline model, and add control parameters into the equation were discussed. The intent of this chapter was to explain the foundations and methodology of DST in order to inform Chapter 4.

Chapter 4 was a study that combined the theory and findings of Chapters 2 and 3. Since Chapter 2 did not show any change in social connection after day 10 of a course, data were collected every day for the first 12 full days adolescent students participated in a 14-day NOLS backpacking course. Social connection was operationalized under the construct of sense of belonging, which can be characterized as "a subjective feeling of value and respect derived from a reciprocal relationship to an external referent that is built on a foundation of shared experiences, beliefs or personal characteristics" (Mahar, Cobigo, & Stuart, 2013, p. 1031). Goal conflict, process conflict, and instructor support were the three control parameters used to assess changes in the system. The baseline model suggested a single fixed-point attractor existed within these data at a value of 0.16 (grand-mean centered) with a rate of change of 0.44. Process conflict showed a significant interaction with the current level of sense of belonging that increased the strength of the attractor by .03 units. Goal conflict did not significantly alter this pattern. Instructor support showed a significant main effect which increased the set point 0.20 units. These findings showed that on average, students stabilized at a relatively "high" value of sense of belonging over the course. Instructors who provide student support were found to be one component within the system that helps students develop a sense of belonging. Furthermore,

this study also showed that process conflict acts as a stabilizer for belonging. When students have moderate levels of process conflict they move toward their set point at a faster rate, which can be positive if their set point resides at a high value or detrimental if their set point resides at a low value. The use of a DST framework allowed us to better understand the pattern of development of social connections and some components of the system that alter this pattern.

The five chapters of this dissertation were written to better understand the development of social connections in the context of OAE. The need for adolescents to socially connect with their peers is critical for their learning and social development during these types of experiences. However, the developmental pattern of these connections is unknown. Furthermore, the multicomponent nature of the social group and OAE experiences make it challenging to suggest that one or two variables influence how these connections develop. Dynamical systems theory provides a foundation that embraces these complexities and does not focus on cause and effect relationships.

Of the multiple variables that were modeled throughout this dissertation, conflict (both goal and process conflict) and instructor support/consideration were consistent predictors of social connection. Program administrators and instructors should help students to clearly articulate and define their goals. While some students may have different personal goals, group goals can provide a commonality between students so as to limit the level of goal conflict within a group. How work is conducted throughout a course will often create forms of process conflict. However, this research suggests that moderate levels of process conflict may not necessarily inhibit the development of sense of belonging. Instructors need to help students communicate and work through process conflict in order to provide a beneficial outcome. Lastly, the importance for instructors to provide considerate behaviors and support students is evident in this

research. While there is often a focus on the competence of technical and leadership skills, instructors also need to develop strong interpersonal skills.

This dissertation provided a novel modeling technique within the outdoor recreation literature. Given the multicomponent and complex environment for this discipline, a DST framework provides a different lens to understand phenomena. To this end, others are encouraged to utilize the principles of DST when conceptualizing and modeling the complex nature of OAE phenomena.

References

Mahar, A.L., Cobigo, V., & Stuart, H. (2013). Conceptualizing belonging. *Disability & Rehabilitation, 35*, 1026-1032.

Thelen, E., & Smith, L.B. (2006). Dynamic systems theories. In M. Damon & R.M. Lerner (Eds.). *Handbook of child psychology* (pp. 258-312). Hoboken, NJ: Wiley & Sons.

APPENDIX

QUESTIONNAIRES

The Group Identification Scale (Henry, Arrow, & Carini, 1999), goal conflict items, and Leader Behavior Description Questionnaire (LBDQ-XII; Stogdill, 1963)

Please respond to the 12 statements below that ask about your perceptions of this group.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I would prefer to be in a different group.	SD	D	N	A	SA
Members of this group like one another.	SD	D	N	A	SA
I see myself as quite different from other members of the group.	SD	D	N	A	SA
I enjoy interacting with the members of this group.	SD	D	N	A	SA
I see myself as quite similar from other members of the group.	SD	D	N	A	SA
I do not like many of the other people in this group.	SD	D	N	A	SA
I want different things from this course than other people in this group.	SD	D	N	A	SA
I want different things from this course than my instructors want from me.	SD	D	N	A	SA
The instructors look out for the personal welfare of group members.	SD	D	N	A	SA
The instructors maintain a closely knit group.	SD	D	N	A	SA
The instructors do little things to make it pleasant to be a part of this group.	SD	D	N	A	SA
The instructors are friendly and approachable.	SD	D	N	A	SA

The Feeling of Social Belonging Scale

Richer & Vallerand (1998)

In my relationships with other students on this course, I feel…..

Do not agree at all 1	Very slightly agree 2	Slightly agree 3	Moderately agree 4	Agree 5	Strongly agree 6	Very strongly agree 7

1. supported. 1 2 3 4 5 6 7
2. close to them. 1 2 3 4 5 6 7
3. understood. 1 2 3 4 5 6 7
4. attached to them. 1 2 3 4 5 6 7
5. listened to. 1 2 3 4 5 6 7
6. bonded to them. 1 2 3 4 5 6 7
7. valued. 1 2 3 4 5 6 7
8. close-knit. 1 2 3 4 5 6 7
9. trusted. 1 2 3 4 5 6 7
10. as a friend. 1 2 3 4 5 6 7

Conflict and Instructor Support Items

Goal Conflict

I want different things from this course than other people in this group.	1	2	3	4	5	6	7

Process Conflict
(Jehn & Mannix, 2001)

Often there are disagreements about who should do the work (group chores) in this group.	1	2	3	4	5	6	7
Doing work in this group is frustrating because only a few people do the majority of the work.	1	2	3	4	5	6	7

Instructor Support (Classroom Life Scale)
(Johnson, Johnson, Buckman, & Richards, 1985)

My instructors really care about me.	1	2	3	4	5	6	7
My instructors think it is important to be my friend.	1	2	3	4	5	6	7
My instructors like me as much as they like other students.	1	2	3	4	5	6	7
My instructor cares about my feelings.	1	2	3	4	5	6	7